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TAXATION OF ZAMBIAN MINES

- THE PROBLEM OF ROYALTIES -

A THESIS PRESENTED TO THE FACULTY OF ARTS AND SOCIAL STUDIES, UNIVERSITY OF GLASGOW, FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

by

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DEPARTMENT OF INTERNATIONAL ECONOMIC STUDIES.

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/ In

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LIST OF TABLES.

CHAPTER I

THE MINING INDUSTRY OF ZAMBIA

Introductory Note

The subject of our dissertation is the taxation of Zambia mines in general. In particular we are interested in the system of royalty payments and the rationale and effect of the current export tax. As we shall see shortly the mining industry of Zambia is the mainstay of that economy. Naturally, therefore, as a necessary prelude to the discussion of the subject matter, we are impelled to give a brief description and analysis of the relationship between this industry and the rest of the economy. This is by way of providing a general impression of the significance of this industry to the economy, noting in particular the relationship between the country's development plan and the industry. This discussion will be invaluable in helping us understand later (Chapter 2, et al) a more detailed analysis of this relationship and the subsequent critique of the whole system of mine taxation. After which, having indicated the likely effects on the budget revenue and on the profitability (or prospective investment yield) of the mining industry of changes in the system of mine taxation, we formally make an alternative proposal of the system of royalty payments (and export duty) which is the centre piece of the whole of our study project.

In Section 2 of this Chapter we discuss, again briefly, the relationship between the copper mining industry of Zambia and the rest of the (major) copper producers of the world. This section is important in that it introduces us to the comparative cost analysis of the various copper mining companies and countries of the world, which we later present. This section and the subsequent section in Chapter 3 on comparative cost analysis is important because if, as we shall see in Section I of this chapter and in subsequent discussions, this industry is the mainstay of the rest of the economy and forms more than 90% of export products, we must feel compelled to present at least

a working framework of the exogenous factors which affect the competitiveness or otherwise of this very important industry. Moreover, such a framework provides a useful contrast to the internal factors such as the system of taxation, etc., which, by and large, can be manipulated to attain certain objectives. After all, our interest is to see whether, given certain external factors such as the demand and the movement of prices in the international copper market, endogenous factors may not be varied to achieve such economic, social or political objectives as would have been envisaged by the Government. Again, it is in the light of this and other background discussions that we later present our alternative system of royalty payments (and export duty).

Section I: THE INDUSTRY AND THE ECONOMY OF ZAMBIA(1)

The mining industry of Zambia is synonymous with the copper industry. This industry is concentrated within a strip of land 100 miles long and 30 miles wide. This is the "Copperbelt" and lies immediately to the south of the Zambia-Congo border and skirts that part of the Congo which juts into Zambia and is known as the Congo Pedicle. This area contains fantastic wealth - over a quarter of the world's known copper ore reserves. It is from such a base that the copper industry of this country has become, after the U.S.A., the second largest copper producer in the free world. This is one reason why the Zambian industry is ranked as one of the "international firms". (Chile has consistently rivalled Zambia as the second largest copper producing country).

The Copperbelt of Zambia supports an urban and rural population of more than half a million out of the country's total population of three and a half to four million.

The industry is owned by two mining groups which, between them, own the seven major producing copper mines and the only three refineries in the country. The Zambia Anglo-American Group (Z.A.A.) produces about 53% of the copper output from its three mines at Bancroft, Nchanga and Rhokana Corporation.

The rest of the output comes from the Roan Selection Trust Group (R.S.T.) mines at Chambishi, Chibuluma and Luanshya. Of the three refineries the R.S.T. owns Mufulira and Ndola; the Rhokana refinery where cobalt is also processed is owned by the Z.A.A.

The Zambia Broken-Hill Development Company (Z.B.H.) is owned by the Z.A.A. and is the only producer of substantial minerals other than copper and cobalt. The company produces, smelts and refines lead, zinc and vanadium. It also fabricates locally produced lead into sheets and pipes. (Sulphuric acid is also produced but the mine in general is currently experiencing technical difficulties in its operations and has been operating at a loss for some time now).

The two groups' rights to prospect and mine are not confined to the copper-bearing ores of the Copperbelt area (Z.B.H. is not on the Copperbelt). The Groups hold in addition the right to prospect and develop what are called the "exclusive rights" and the "special grant" areas, which, between them, cover nearly all prospective copper-producing or copper-bearing territory.

With the exception of Chambishi and the two open pits at Nchanga mine, production is by underground mining and practically all the copper produced is primary or virgin, i.e. mined copper. Secondary copper, i.e. copper produced from old scrap is negligible in Zambia.

Operationally, there is mutual cooperation and interdependence between the two Groups. Moreover, the Z.A.A. has minority interests (about 30%) in stock of the R.S.T. mines at Mufulira and Chibuluma mine. Jointly, the Groups control the Zambia-Congo Border Power Corporation Ltd. which, until the Kariba Hydro-electric Scheme came into production, was the main electricity supplier to the mining areas; the R.S.T. refinery at Ndola takes copper for Z.A.A. mines when the Rhokana refinery is fully employed. The attached Table I illustrates more fully the special financial relationships of the mining Groups and companies within Zambia.

Table I

Z.A.A. GROUP OWNERSHIP 30th JUNE, 1966

Company	Z.A.A. Holdings	Holdings by Subsidiaries of Z.A.A.	Combined Holdings of Z.A.A. and Its Subsidiaries
Z.A.A. GROUP			
Rhokana Corp -oration Ltd.	13101640	-	52.4%
Nchanga Consolidated Co. Ltd.	6266667	11110574	54.3%
Bancroft Mines Ltd.	-	24839582	99.4%
Rhokana Copper Refinery Ltd.	-	1700000	100.0%
R.S.T. GROUP			
Mupilira Copper Mines	572213	4213525	30.2%
Chibuluma Mines	271695	2001180	30.3%
Chambishi Mine	175879	1295430	30.2%
Baluba Mine	20826	153421	30.3%
Chisangwa Mine	5700	366900	30.5%

Source: Z.A.A. Annual Report (and Consolidated Balance Sheet), 1966

Note: In some cases company holdings are not disclosed.

There is also considerable external control exercised on these mining groups. For instance, the Z.A.A. is controlled by the A.A. Corporation of South Africa Ltd.; the U.S. Corporation American Metal Climax has 46% interest in R.S.T. These corporations[2] have various interests and control power elsewhere in the world. The A.A. Corporation, for instance, is mainly a gold-mining finance house, and has various interests in industry and mining; the American Climax has minority interests in e.g. The Copper Range Corporation, etc. Thus, in this sense too, the Zambian industry is an international firm.

The industry operates in a market structure which cannot be precisely categorised into any one of the theoretical market structures. From the point of view of the Zambian producers and other major producers of the world, the market is basically a collusive oligopoly. This is mainly because primary copper is essentially an undifferentiated product which is sold by the few producers to several consumers. The prices are, however, contract prices and these usually cover a fairly long period. But because some (small) producers sell their primary copper on say, the LME, on a competitive rather than a contract basis, and that secondary copper, which is a close substitute of primary copper is also competitively supplied on the LME, etc., this means that there are no longer a few sellers in the market. Buyers can thus move between the various aspects of the market thereby modifying considerably the oligopolistic nature of the primary copper market.

In so far as the Zambian industry is a collusive oligopoly the producer companies can maximise their profits by doing one of two things at a time: either determine the price for any quantity of supply, or determine the supply for whatever price this might fetch, given demand. But since the copper market as a whole is not oligopolistic, we can expect that the supply and pricing policies of the Zambian industry will be greatly modified by the supply, demand and price conditions of the copper market in the international economy.

From the point of view of production or supply, we have pointed out above that Zambia is one of the major producers of primary copper in the international economy. Currently, the industry is responsible for a contribution of between 14% to 16% of free world copper output. This feature does mean that the industry must exercise considerable influence on the overall tonnage or supply of copper in the world. To the extent that this is done, the Zambian industry exerts considerable influence on the price of copper in the international economy. Indeed, in so far as consumption reacts to real or potential supply, the Zambian industry must also have influence on the trend or expectation of demand for copper in the world economy. That is, if consumers expect an ample supply or shortage of copper, they can be expected to adjust their consumption plans accordingly, and this will in turn be reflected in overall demand for copper. Hence, in this sense, we can say that ultimately supply, demand, and price of copper in the world economy will bear some relationship to the production (and costing) of the Zambian copper industry.

Now, over the years, mineral production in Zambia has continued to rise both in absolute and relative terms. Although mining in general is one of the oldest human occupations in the world it was not commercially significant in Zambia until after the end of the first quarter of the present century. As Table 2 shows, the growth of copper production in particular was rapid especially in the early years of the industry's development, i.e. before the war. Progress continued to be made especially after the war. This trend is evident in our table.

Thus, from a negligible quantity in 1930, output rose significantly by 1934, and remained constant for the subsequent years until in and after 1938, when it rose sharply, reaching a peak in 1942-43. The observed decline in output after this date was mainly the result of two factors: first there were technical difficulties confronting some mines; secondly, while the rapid growth in production immediately before and during the heat of the war was a

response to war material requirements, the demand for these war requirements declined with the gradual cessation of the war. The steady rise in post-war demand, reflecting war-reparation and civilian requirements, gave the producers the necessary incentive to expand production and output capacity in the post-war years. The devaluation of the pound sterling in 1949 was also a powerful incentive to the producers (the pound/price for sales in U.K. increased 44% overnight).

As the industry has continued to expand, its relative importance in the economy has also increased. Today the industry is the biggest sector in the money economy while its role expands proportionately to its growth. Thus, the development of the Copperbelt is practically responsible for the growth of such towns as Ndola and the springing up of such commercial and technical activities as store businesses, transportation and engineering in that part of the country. It is known that apart from the direct expenditure on itself, e.g. wages, and other domestically produced inputs, the mining industry in general spends about one-third of its revenues or earnings within the country. Such indirect expenses would include, for instance, railway freightage, timber and electricity purchases and service charges (say, schools, shops, hospitals, roads, etc.) on the Copperbelt. All this must have stimulating effects on the development of other industries and ancillary services.

In a more direct way, the industry has been largely responsible for the growth of the economy through its contribution to the Exchequer. In general it may be said that the copper mines today provide 60 to 70 per cent of the Zambia Government's revenue. Thus, in 1965, the industry contributed a sum of £66m. out of a total Government revenue of £95.6m. - a figure equivalent to 69.0%. Indeed, the various implications of this observation is one of the main reasons why we undertake this study.

The industry's development as an export sector has been similarly spectacular. It is estimated that between 1945 and 1953 copper production

Table 2

MINE PRODUCTION

(Selected Years)

Year	Zambian Production Short Tons	World Production Thousand Short Tons	Zambian Production as Percentage of World Production
1926	793	1,665	.047%
1930	9,513	1,765	.54%
1934	176,511	1,415	12.47%
1938	280,983	2,225	12.62%
1942	276,199	2,945	9.38%
1946	211,143	2,040	10.35%
1950	327,923	2,760	11.88%
1954	438,708	3,110	14.10%
1958	441,073	3,750	11.76%
1962	619,856	4,834	12.82%
1965	756,000	5,423	13.94%

Source: U.S. Bureau of Mines

alone constituted about four-fifths of total export value. Currently, the percentage contribution is around 90% of total exports. Thus, in 1965, Zambia's total exports were valued at £187.5m., and of that £181.1m. or about 96.6%* was accounted for by mining alone. There are indeed several criteria by which the significance of this industry to Zambia can be illustrated. Table 3 below simply buttresses, in perspective, the observations just made. Indeed the parameters shown are sufficient to demonstrate our point.

Table 3

ESTIMATED CONTRIBUTION OF THE ZAMBIAN COPPER INDUSTRY TO NET DOMESTIC PRODUCT, GOVERNMENT REVENUE AND DOMESTIC EXPORTS OF ZAMBIA, 1958 to 1967

Year	Net Domestic Product	Contribution to Net Domestic Product		Government Revenue	Contribution to Government Revenue		Value of Domestic Exports f.o.r.	Copper & Cobalt Value of Exports	Copper & Cobalt Contribution to Exports
	(K mill.)	(K mill)	%	(K mill.)	(K mill)	%	(K mill.)	(K mill.)	%
1958	261	90	34	56	18	33	151	140	92
1959	354	167	47	55	14	26	237	220	93
1960	390	196	50	63	23	37	260	243	94
1961	375	177	47	75	28	38	241	224	93
1962	369	171	46	75	26	34	241	222	92
1963	387	173	45	72	25	34	260	239	92
1964	457	215	47	108	57	53	327	302	92
1965	576	246	43	189	134	71	375	348	93
1966	726	342	47	255	163	64	490	466	95
1967	769	296	38	268	150	56	465	440	95

Source: Zambia Mining Year Book, 1967, p.2

Notes: 1 Kwaca = 11/7 British currency
= $ 1.4 (U.S.A.)

*Source: Brown Commission Report, 1966.

The least that one can say is to wonder what the economy of Zambia would have been without mining in general, but copper production in particular. This is the industry that earns practically all the foreign exchange so crucial for development; and this is the industry that finances more than two-thirds of the country's development programmes. This is the industry that directly provides employment to about 16% of the country's work force. No doubt, as the economy develops, this preponderance of the mining sector will tend to diminish, relatively, as the contribution of other sectors increases. Of course this is the obvious implication of a programme of economic diversification and is one of the major aims of development in Zambia. Even so, however, mining must remain central to the economic well-being of Zambia for a long time.

The extent to which Zambia can rely on her industry for economic development will depend, on the one hand on the quantum of mineral resources to be tapped and, on the other, on the market conditions for the industry's product over given periods. Market conditions of a product are essentially determined by the nature of supply and demand for that product. In the case of Zambia, whereas supply can be influenced by the producers, demand for the product is largely an exogenous factor. Hence, given the resource base and the demand for the product as data, Zambia's growth potential or prospects will largely depend on her industry's ability to compete against producers of that same product in the world economy. That is why we must now attempt to review the Zambian industry in relation to its competitors in the world copper industry. A brief but critical analysis of the development of demand is an essential part of this review.

Section II: <u>ZAMBIA COPPER INDUSTRY IN WORLD ECONOMY</u>

In Table 2 above we noted the growth pattern of production of Zambia mines in relation to the total world production of copper. The pattern is evidently impressive, showing a rapid rise in the early stages of exploitation

of resources and then more or less a constant rate, reflecting in turn the fact that expansion possibilities were being more fully exploited with the passage of time.

In order to appreciate more fully the relationship of the Zambia industry to the world copper industry, we must make a comparative study of the various copper producers of the world with respect to their production dimensions. This way we should be enabled to appreciate once more the extent to which the economy of Zambia can depend on her export industry, given the competitive advantage or otherwise of other producers. Given the resource base and demand conditions, the competitiveness of the various producers can be said to be reflected in their relative contribution to total world production.

To simplify the problem, we refer ourselves to Table 4 below, in which we may observe the relative production dimensions of the various major copper producing countries of the world.

Table 4

THE WORLD'S MAIN COPPER MINING COUNTRIES, 1958-1967

(Mine production in terms of recoverable copper content, 000's tons)

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
U.S.A.	979	825	1080	1165	1228	1213	1247	1352	1429	948
USSR	463	485	551	595	646	661	772	827	854	882
Zambia	441	599	635	634	620	648	697	767	687	731
Chile	512	601	586	603	617	663	685	645	701	729
Canada	345	395	439	439	465	458	487	510	508	598
Congo(K)	262	311	333	325	327	299	305	318	349	353
Peru	59	53	212	218	184	196	196	196	203	205
S. Africa	55	56	53	60	53	63	67	67	137	134
Japan	90	94	98	106	114	118	117	118	123	130
Australia	85	106	122	107	120	127	117	101	122	98
Other	513	517	572	562	576	650	646	682	718	740
World	3804	4042	4681	4814	4950	5096	5336	5583	5831	5548

Source: Zambia Mining Industry Year Book, 1967, p.32.

Notice first the fact that Zambia's contribution in absolute terms in each year for the period observed is consistently superior to practically all free world producers except the U.S.A. The Soviet Union's production is superior to that of Zambia for seven years out of the ten years observed. One can argue that in 1958 Zambia's relatively low production reflects the copper slump that took place in the free world during that period. The effect is more pronounced in the case of Zambia because the rate of growth of g.d.p. for U.K., Zambia's major copper importer, was amongst the slowest of the major developed economies of the West that year (G.D.P. for U.S.A. = -0.9%, France = 2.6, UK = 0.9%, Germany = 3.2%). The Soviet Union would not be affected by this factor, which may explain the higher output there. Between 1962 and 1964 the fast rate of growth of the Soviet economy seems to be reflected by a copper tonnage higher than that attained in Zambia. This is presumably because the rate of economic development of countries mainly supplied with copper by Zambia was comparatively less impressive than that of the Soviet Union. In Zambia itself this was a period when economic development was barely perceptible. In any case, the consumption of manufactured copper by Zambia would be insignificant in relative terms, even at the most ambitious rate of economic growth. The effect on total tonnage would be correspondingly negligible. But the post-independence years (1965-67) would undoubtedly have seen a better tonnage for Zambia had it not been for the disruptive effect on production of Rhodesia's U.D.I. (which we discuss more fully later).

The second point to note is that Zambia's output shows a significant increase in each subsequent year for practically the whole period observed. It can also be seen that after the recession the rate of growth of output is more favourable in the case of Zambia than in that of most other producers (although this in itself would not necessarily establish that Zambia was much better placed with respect to production possibilities). The 1966 tonnage is of special relevance to our present discussion. Not only because this

represents nearly 12% of total world production (or about 14% excluding the USSR), but principally because it breaks up what appears to have been a rising trend. As we explain later, and hinted earlier, the apparently sudden fall in output during this period was largely the result of fuel shortages which was itself the result of the economic war between Zambia and Rhodesia after the latter's U.D.I. In contrast, the higher tonnage in 1967 tells of the fact that the lesson of the preceding year had been well learnt: for instance, the level of coal supplies had now been improved by massive stockpiling and so enabled normal smelting to be resumed. Similarly, concentrates had been stockpiled in order to maintain a normal rate of production in subsequent periods. Coupled with the fact that there were no losses due to strikes, the increase of about 33,000 tons in 1967 over 1966 is easily explained.

Thus we can say that in the absence of the artificial constraints just mentioned, the production possibilities of the Zambia mines are encouraging. The effective constraints will therefore be largely geological. That is, all things being equal, the expansion potential of the Zambian mines will be determined by the nature of the inherent cost considerations, i.e. costs due to the geological nature of the locality of ore reserves. Thus, if for instance, Chilean producers are comparatively low cost producers, they would be in a more favoured position to expand production. The reverse would also be true. As it happens, Chilean producers are geologically more favoured than the Zambian ones.(3) The question of mining costs is more fully discussed in a subsequent chapter. It is there shown that Zambia's mines are, at the prevailing level of costs in the world, less competitive not only against Chile, but other countries as well. The economic implications of this observation are there also analysed.

Given that the ultimate purpose of production is revenue in terms of price (+ profit) per unit, the level of demand is critical. This we know as well as the fact that the price per unit is the result or emerges as a consequence of

the inter-action of supply and demand. In the case of the Zambian industry in question we also know that demand is largely an exogenous factor. Thus, as hinted earlier, in determining the value of production, the Zambian producers have only one major variable under control, i.e. supply. Otherwise stated, this is the only variable under their control that they can employ to influence price. Hence, against supply, a discussion of demand and price is in order.

In retrospect we can say that in the post-war years there was a general slackening of demand for copper from late 1950's to early 1960's. As discussed more fully later, this was the reason for initiating various producer price support schemes. Towards 1966, demand picked up and in order to stabilize prices downwards, to avoid consumer substitution, a producer stabilization scheme was in force, side by side with the freely fluctuating LME prices. When in April 1966 the producer scheme gave way to demand pressures and collapsed, demand slackened once more. This slackening became apparent towards the end of 1966, and continued throughout the middle of 1967. Two main factors account for this phenomenon: first, this is a period when there has been a noticeable slowing down in the economic activities of Europe; secondly after the big copper buying rush between 1964 and 1966, consumers were no longer afraid of possible supply shortages, i.e. supplies were no longer as uncertain as in the earlier years (i.e. improved production prospects in Zambia).

In fact, despite curtailed production in Zambia due to Rhodesia's UDI and uncertainties in regard to supplies from Congo (K) which is another major copper exporting country, copper appears to have been freely available on a world-wide basis (a considerable amount of copper came from the smaller producers, intent to cash in on the attractive world-wide copper prices - all contributing to the slackening in demand. As we would expect, this

slackening was reflected in the trend of the LME prices which was significantly being pushed downward. (See Table 5, and accompanying graph). (P. 16 & 16-1)

Specifically the demand for Zambian copper seems to have followed the world-wide demand trend. Our Tables 8 and 9 indicate (Pp. 21 + 22) first that total exports to Zambia's major consumer, U.K., fell between 1965 and 1967. The fact that total British copper imports fell during the same period seems to corroborate legitimately our observation. Indeed, since a slackening in world demand largely implies a slackening in the demand of the industrial countries like U.K., this can be expected to reflect on the demand of the major raw material supplying countries like Zambia.

From about the middle of 1967, the market has been influenced mainly by two related factors: first, by the possibility, and second, by the reality, of a strike in the U.S.A., which has affected nearly all copper mines and plants in that country since mid-July. There is little doubt that had it not been for this strike a fairly substantial free world copper surplus would have become apparent during 1967, and we could have expected an LME price below the current year's lowest level. Instead the effect of all this was to convert the potential or estimated world surplus into a real shortage. In consequence, the users of American copper in particular endeavoured to obtain their supplies elsewhere. This in turn was reflected by steadily rising prices in markets like the LME.

In so far as demand can be forecasted, a revival in the trend is a possibility. However, for the near future at any rate, indications of a possible industrial revival in demand in Europe appear to be somewhat mixed. On the whole, one can only be optimistic. The upward trend of the LME prices in the first quarter of 1968 would seem to strengthen this

TABLE 5

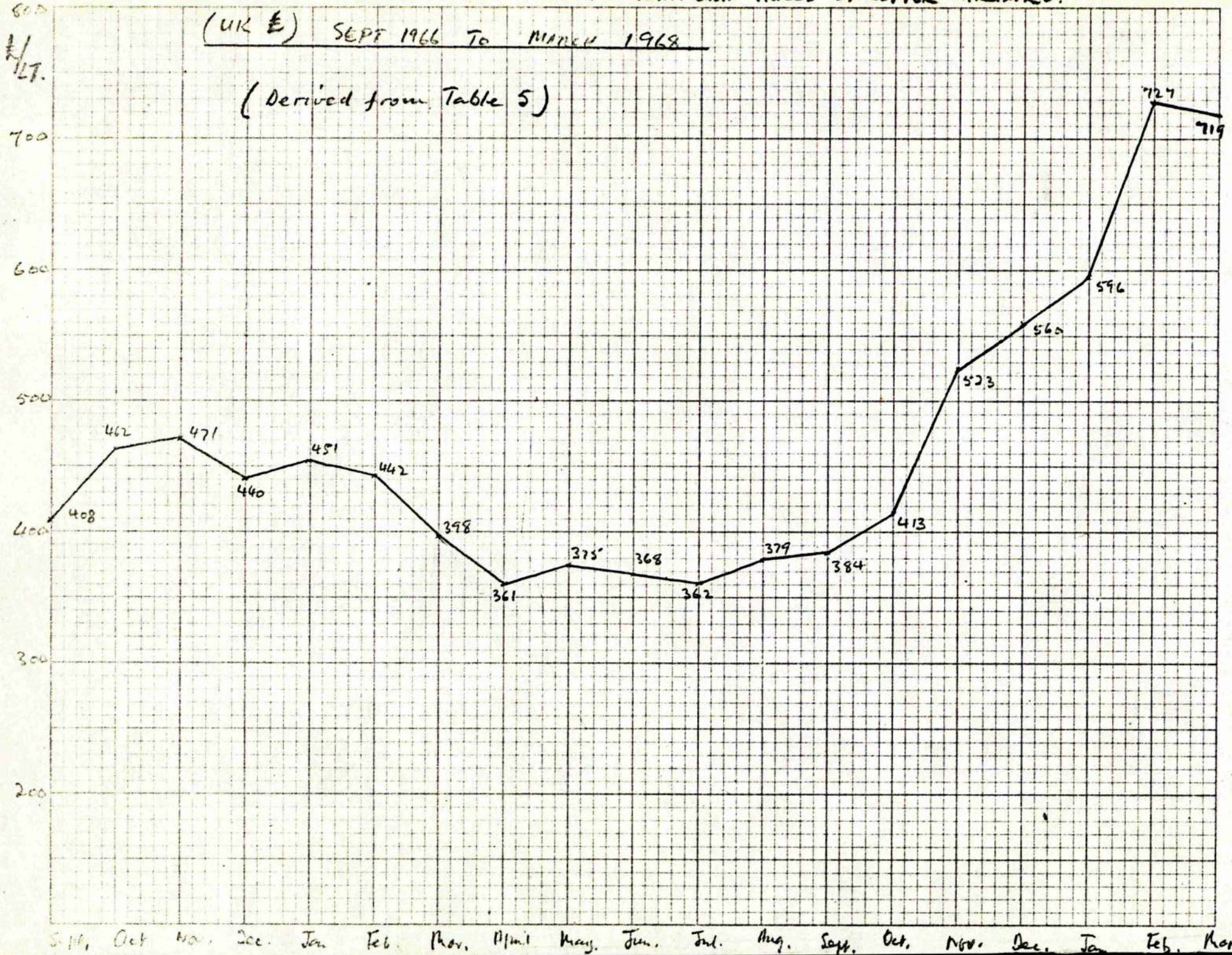
Monthly Average London Metal Exchange
Mean Cash Prices of Copper Wirebars

Year	1965	1966	1967	1968
Month				
January	362	608	451	596
February	426	679	442	727
March	448	679	398	719
April	488	690	361	
May	499	602	375	
June	474	614	368	
July	411	568	362	
August	438	433	379	
September	481	408	384	
October	508	462	413	
November	532	471	523	
December	550	440	560	

MONTHLY AVERAGE LONDON METAL EXCHANGE MEAN CASH PRICES OF COPPER WIREBARS.

(UK £) SEPT 1966 TO MARCH 1968.

(Derived from Table 5)



optimism. What we can say for certain, however, is that the U.S. strike and the war in Vietnam would have an appreciable effect on demand should there be any change in the situation of either. For Zambia in particular, prospects will be brighter once the British Government relaxes the grip or the financial squeeze on its economy.

In order to maintain a balance in our discussion, after supply and demand, we now attempt to present an analytical description of the price of copper. Empirically the most significant feature of the LME price is its apparently continued and seemingly unpredictable fluctuations. While the producer stabilization scheme was in operation (1964-66), fluctuations had been minimised, and the price levels had been toned down, at least in the producer market. On the day this scheme collapsed, LME prices were affected downwards. The attached graphic Table 7 shows the trend of LME between 1958 and 1967, and the producer price between 1964 and 1966 (P. 19.1)

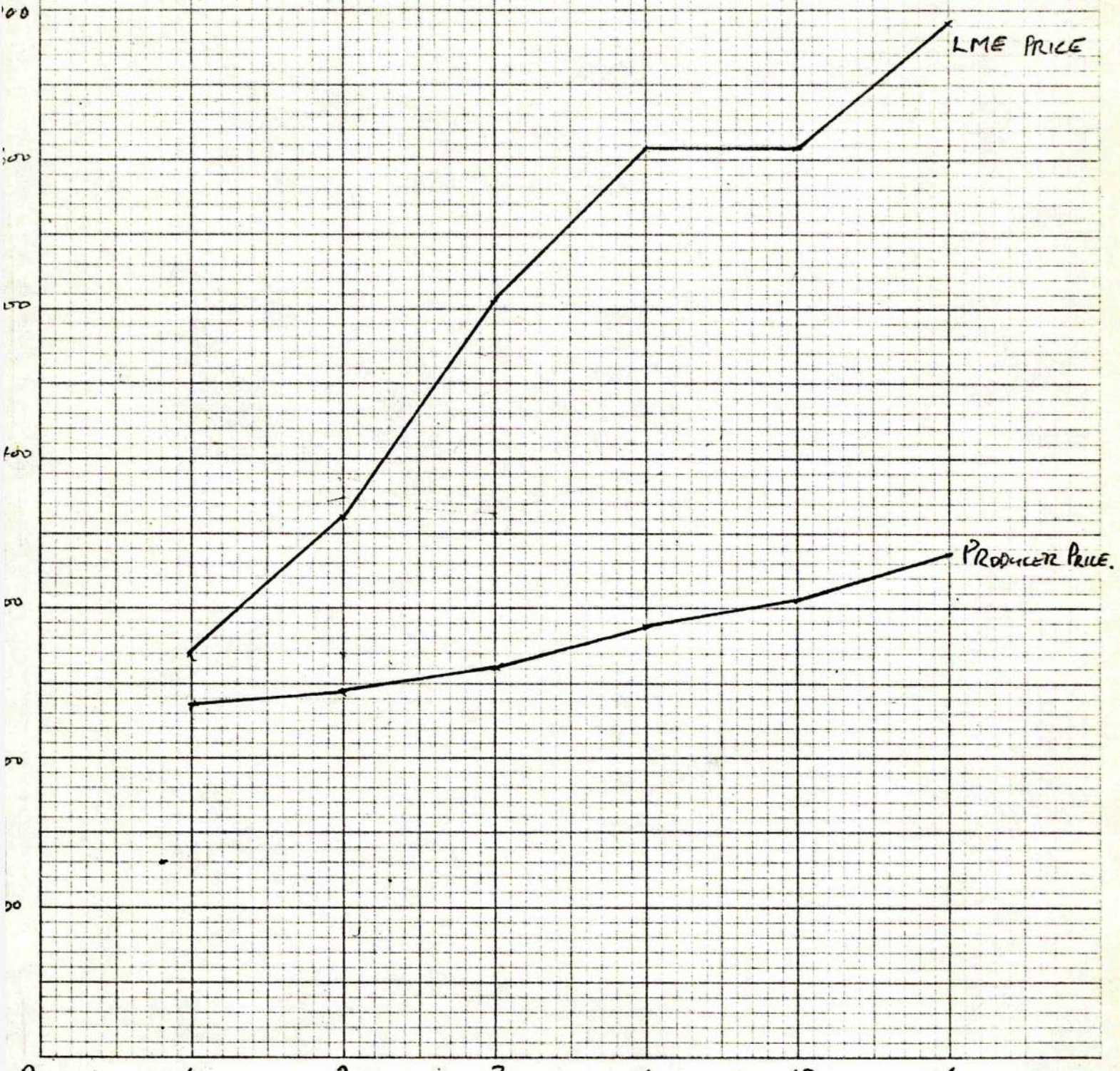
Currently, any seller can set his price. Thus, since the break-up of the producer stabilization scheme, Zambian producers price their copper on the basis of the LME's three months' sellers' price. For its part this price is reported to have fallen at one time to under £340 per ton — its lowest level for just over two years. The price was in fact stable in the £340-£360 range towards the middle of 1967, and was £459 by the end of the year, compared to £452 at the beginning. The average price received for Zambian copper during 1966 was just over £400 per ton. This represented an increase of a little over £100 per ton over the price received in the previous year for the first nine months of which Zambia's copper was sold at a nominated price considerably below the LME level (See Table 6 and accompanying graph) (P. 17.1)

Similarly, other producers, e.g. Chile, no longer bound by any terms of producer agreements, have also since sold their output at the price of their own choice. In all cases the prices elected by the large producers in particular will be considerably higher than any that had

Fixed Copper Producer Prices and LME Monthly Average (£/LT)

Table 6

Period	Producer Price	LME Price Range.
16-1-64 To 13-3-64	236	237.67 To 270.0
13-3-64 To 17-8-64	244	270.0 To 361.8
17-8-64 To 3-6-65	260	361.8 To 526.4
3-6-65 To 20-10-65	288	410.5 To 608.5
20-10-65 To 3-1-66	304	468.8 To 608.8
3-1-66 To 25-4-66.	336	608.5 To 670.8



been quoted during the life of the producer scheme. It is unlikely that under this scheme producer prices could have gone this high. Otherwise the rationale of the scheme would not be tenable. We could, however, have expected those prices to rise comparatively moderately to take account of a buoyant market.

Like producers, consumers are keenly interested in the level and trend of prices though their economic effect may be different in each case. With special reference to LME and LME-based prices, there have been consumer outcries regarding their recent level and fluctuations in the copper market. Lord MacFadzean, Chairman of the British Insulated Callender's Cables Ltd, (BICC), in his annual statement to the shareholders (1967) seems to have expressed the general view of the users or consumers of copper regarding the copper price trend in recent times. He admitted that considerable quantities of copper would still be used in his enterprise, but, he added, "the rate of growth would be nothing like it could have been with reasonable volume of supply and stability of prices. Can users be expected to plan major schemes of electrification, involving considerable quantities of other metal with any confidence when they do not know whether copper will be £300 or £700 a ton?"

This is precisely the kind of situation which the producer stabilization scheme had been intended to remedy, or, at any rate to modify. Producers are always worried about the loss of customers due to fluctuating, and sometimes avoidably high prices. Long-term considerations are invariably paramount for both the consumers and especially the big producers of copper. If the producer industry is to survive for a long time, it must strive by all means available to avoid any influences that tend to stifle or divert demand from it in the short run as well as in the long run.

Producer concern with stabilization is as old as the industry itself. In the U.S.A. it culminated in the formation of a highly integrated

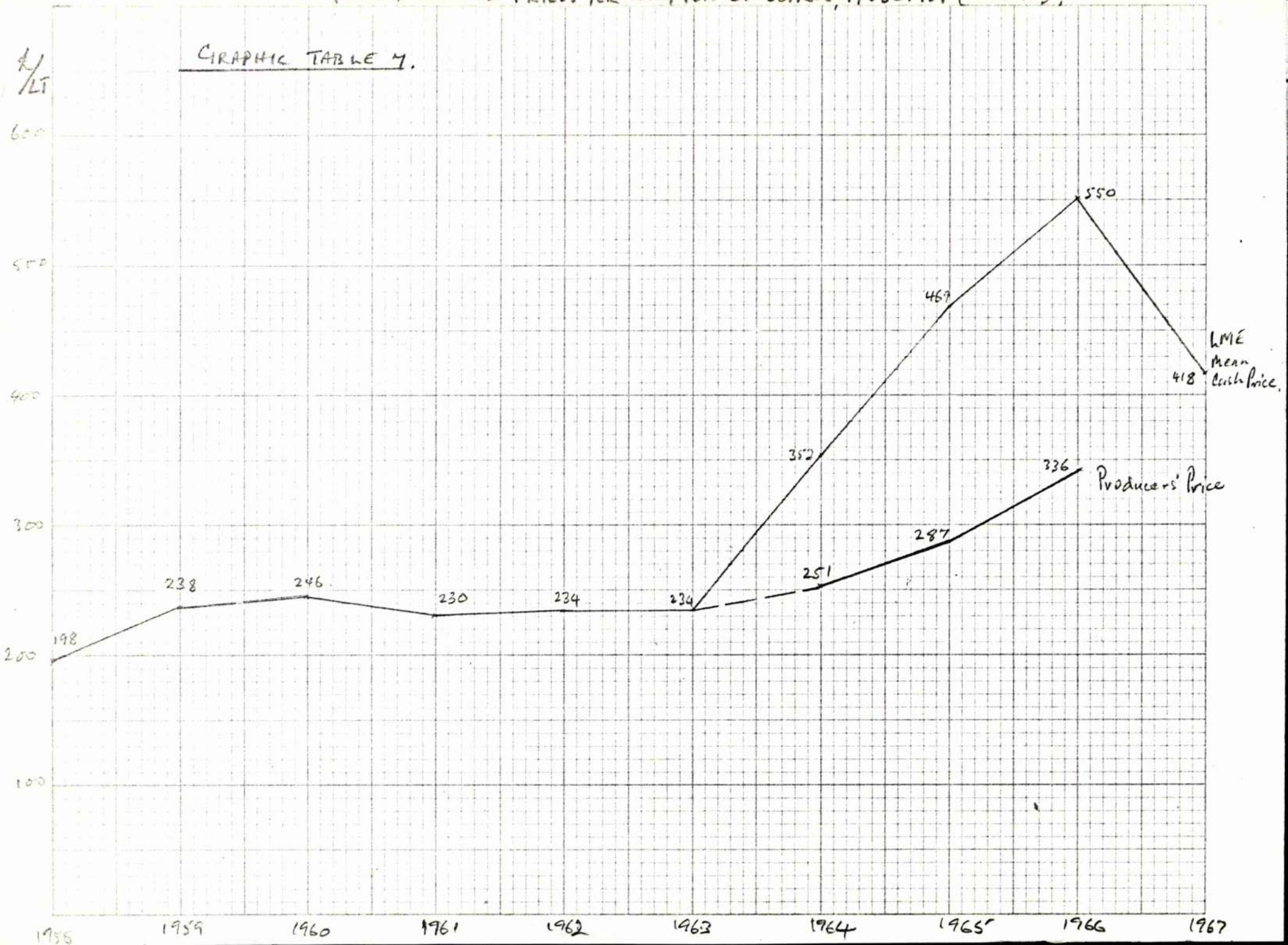
copper market as early as in the 1930's. More recently, Sir Ronald Prain, Chairman of Zambia's R.S.T., had already begun worrying about the effects of the price ~~functions~~ fluctuations as early as in the 1950's. Thus, in less than two years from August 1954, the price is reported to have nearly doubled to £420 a ton, only to slump to £160 a ton by the beginning of 1958. Sudden swings like those worry producers understandably. As pointed out already, at high prices there are prospects of losing the market because of substitution (e.g. aluminium, plastics). At low prices the mines in which millions of pounds are invested lose money. Which is why Prain attempted in 1956 his own single-handed stabilization scheme, quoting a price for his product below and quite independent of the alarmingly high LME price. But, as many other such schemes before and after it, this one-man attempt failed, allegedly because other big producers had stayed out of the scheme.

The apparent sliding of copper price in 1961 to a level of £200 a ton provided the opportune moment for the untiring Prain to initiate this time with the help of or in conjunction with the other major copper producers, his second attempt of a producer scheme - ostensibly to support the sagging price. It is this scheme which, having comparatively succeeded in keeping producer prices stable at around £234 a ton up till 1963 and formally launched in 1964, finally gave way to supply and demand pressures and collapsed in April 1966 (see Graphic Table 7). Nothing has so far taken the place of this defunct producer scheme, and producers continue, as before this and other schemes earlier, to live with their fears and do the best they can, even if this has meant for producers like those of Zambia, a return to the LME. Indeed, as we point out in the following section, the very attempt by producers to segregate the LME from the rest of the copper market was a short-sighted and economically unsound solution to the fluctuations problem.

Currently, with prices still on the upturn compared to the late 1950's and early sixties, the main fear of the producers is copper substitution. How

YEARLY AVERAGE PRICES PER LONG TON OF COPPER, 1958-1967 (41K L).

GRAPHIC TABLE 7.



much actual substitution will take place, will of course, partially depend on factors other than the price of copper e.g. technological change due to research. Thus, the raw material users are constantly searching for production processes which are not only cheaper in terms of input costs, but also more efficient in terms of say, size and performance. Here the price of copper as an input cost as against that of other commodities, is not a critical factor to the user in the short run.

But all things being equal, the level and the trend of prices of a commodity will determine how much of that commodity can be had in view of the prices of all other commodities which could well be demanded by consumers to satisfy their particular needs. In fact it has recently been shown that at least in some lines of production copper has lost out to aluminium because of the relative price advantage of aluminium over that of copper. To the extent that this is true, Lord McFadzean's plea or warning is vindicated.

The line of production in question is the electricity supply industry of Britain. This industry is the biggest single user of copper in the United Kingdom. It takes about 40%(4) of the estimated 770,000 tons of copper consumed annually. It is here where copper is said to be in the greatest danger of losing out to aluminium mainly because of the latter's price instability. It is estimated that in 1965, 36,000 tons of aluminium (which is equivalent to a little more than twice that tonnage of copper) went into electricity supply. In 1963, before copper prices swung upwards the estimated consumption was only 23,000 tons. Significantly this build up had been taking place despite aluminium's technical difficulties and drawbacks. More specifically, size for size aluminium has only 63% of copper's electrical conductivity, its mechanical strength is appreciably less, and it is a far more difficult metal to solder. The switch is most noticeable in cables which account for effectively half the electricity industry's annual intake of copper.

Admittedly, this evidence on its own is far from being conclusive from in establishing the proposition that there is a positive causal relationship between price and consumption or demand for copper in the international market. But in so far as Britain imports about one third of her total copper supplies from Zambia, then figures like these are not unimportant for Zambian producers (and the Government) to take note of. The point is that should the process of substitution in Britain become significant, the greatest loser or victim will be Zambia. Reduced exports from Zambia to U.K. means reduced foreign earnings on which so much of the economy depends. This observation is particularly strengthened by the fact that Zambia's chief copper importer is Britain. In this connection the table 8 below appears to be instructive.

Table 8

SALES OF ZAMBIAN COPPER TO CUSTOMER COUNTRIES

1965-1967 (000's Short Tons)

	1965	1966	1967
France	60	55	55
Germany (West)	110	100	86
Italy	60	60	57
Japan	100	105	144
Spain	5	5	8
South Africa	30	30	24
Sweden	15	15	18
Switzerland	10	10	11
United Kingdom	280	230	199
U.S.A.	10	5	20
U.S.S.R.	10	5	Nil
Other	40	45	45
Total	740	665	667

Source: Zambia Mining Industry Year Book, 1967, p.40

Table 9

TOTAL COPPER IMPORTS TO UK, 1965-67

(000's tons)

Year	Tons
1965	584
1966	509
1967	451

Source: Trade and Navigation Accounts of U.K.

Notice that in the case that interests us most in Table 8, copper sales to Britain have steadily been falling off since 1965. This is also true of total sales made abroad by Zambia. Furthermore, in each case the absolute decline in quantities in each succeeding year is significant. Of course there is nothing in all this to suggest, a priori, that recent high copper prices have led to substitution by British copper users and that this is what is being reflected by falling off of Zambian copper exports to U.K.

But if read in conjunction with Table 9, in which U.K.'s total copper imports during the comparable period are shown, the Zambian copper exports to U.K. are at least suggestive of the possibility of Zambia's loss of overseas market due to substitution. In the specific instance quoted earlier, we noted that the observed substitution in the British electricity supply industry was assumed to be due to the unfavourable trend of the copper prices. The effect of substitution for any reason whatever would be reflected ih falling copper imports to U.K. This in turn would affect adversely the countries normally supplying U.K., e.g. Zambia. Both these possibilities are suggested by the two tables above. We are thus inclined to conclude that at least part of the decline in output exported by Zambia during the years observed was the result of substitution due to unfavourable copper prices abroad, i.e. U.K.

This is precisely the kind of situation feared by the Zambian producers in particular. Thus they are especially outspoken in their desire to maintain stable and often comparatively low prices although the Government has consistently adopted a contrary attitude. Thus while producers have sold their copper at prices relatively lower than those at LME, the Zambian Government has nonetheless based its royalty tax on the prices ruling at LME and which are invariably higher than the producers'. Both sides appear to have valid reasons for adopting a particular attitude to LME prices. Our own position is stated in our criticism of the whole system of royalty payments as currently assessed. Otherwise there is no doubt that high prices are advantageous especially to the Government in so far as these raise the level of taxable company profits, at least in the short-run. But it is equally right that the industry must concern itself not only with short-run benefits, but also with long-run survival. This is also in the interest of the economy as a whole.

MARKETING AND PRICING OF COPPER: THE ROLE OF THE LME (AND COMEX).(5)

So far we have been talking of a copper price, the supply and demand of copper as though there were just one such price, supply and demand schedule for the various types or forms of copper. This simplified assumption of the copper market was necessary in order to keep the objective of our analysis within manageable proportions. We now relax that assumption and attempt to make a concise description and analysis of the nature of copper, its marketing and pricing. The analysis is significant to the extent that it throws some light on to the problem that faces primary copper producers in the marketing of their commodity. The analysis must therefore be invaluable also to the Governments of those producers. This will be especially so to those Governments whose revenue incomes largely depend, like the Zambian Government's revenue, on how best and how well their export sectors sell the products. Indeed, any tax policy formulation or changes must proceed from the knowledge of product

marketing whether such a policy is intended to raise the profitability of the given producer, or to change the level of tax revenue to the State.

The medium and large scale copper companies of the world are almost without exception selling their primary copper directly to users. This is particularly true in the case of the American copper industry which is highly integrated from mining to the semi-fabricating or fabricator stage. The giants in this system at the production level are Kennecott, Anaconda, and Phelps Dodge mining groups. Outside the U.S.A. there is very little integration. Even so, major copper producing companies like R.S.T. and Z.A.A. in Zambia, Noranda in Canada, Mount Isa in Australia, and Katanga's Union Miniere, still manage to deal directly with their consumer customers. Only small copper mines, custom smelters and custom refineries would sell their primary copper to metal merchants especially on the LME. Amongst these are, for instance, Cerro de Pasco in Peru, Bolidens in Sweden, and Messina in South Africa. It is obviously more attractive and more profitable for the smaller producers to sell at higher prices (e.g. LME prices) than at the comparatively lower producer prices designed to stabilize the long-term market. They are able to cash in on this higher price without necessarily running the same degree of risk as that feared by the major producers. Theirs is a freely available and variable supply mainly in response to short-term requirements of the market.

About 70 to 75 per cent of copper in the free world is sold and bought outside the LME (and Comex). That is, only 25 to 30 per cent of copper is dealt with at the LME, and is mainly secondary (or scrap). There is, nonetheless, a positive relationship between the copper price at LME and that charged by big producers outside that market. The relationship is, of course, not defined in strict terms - like, say, fixed ratios. Rather it is like that of a leader and a follower: the leader picks up a price, and the follower adjusts to it as well as he can. Invariably, the LME price leads the way, and the producer price adjust to it up or down. This is evident in Table 6 (P.17.1) and the

accompanying graph.

The marketing of secondary copper is somewhat complex. To begin with, the new scrap is consumed in the fabricator plants: it never reaches the market outside the plant. Part of the remainder of the new scrap would partly be bought by custom smelters and refineries who would sell it in a refined form. Any more remaining new scrap and all old scrap would be bought by metal merchants. This scrap includes copper alloys. A considerable part of the scrap handled by metal merchants is sold directly to fabricators to be reactivated by them in their production processes. This reactivated scrap consists of clean heavy copper scrap, brass and bronze scrap which is chiefly used by brass and bronze mills. Contaminated scrap in the possession of metal merchants has to be refined. Metal merchants would either sell the unclean scrap to custom smelters or would commission custom smelters and refineries to refine it for them. In normal times metal merchants would sell their secondary copper mainly from their offices; only a small part would be sold through the LME and Comex.

Comex is a relatively insignificant market dealing in about 25% of world sales. Unlike the LME, the Comex is dominated not by metal merchants, but by a few custom smelters and a few large integrated copper producers. Comex might therefore be regarded as essentially a producer metal exchange. As such it is unable to generate prices that would reflect the interplay of supply and demand for the whole copper industry. As in the case of any producer market, most of the time prices follow supply conditions and are not responsive enough to demand conditions. Because seller and buyer are bound together by long-term contracts, prices will be maintained at given levels despite the change in the balance of supply and demand.

We would thus find that during periods of excess demand, the spot prices would not be high enough. This would encourage excess consumption. If the domestic supply continued to be inadequate, this excess consumption

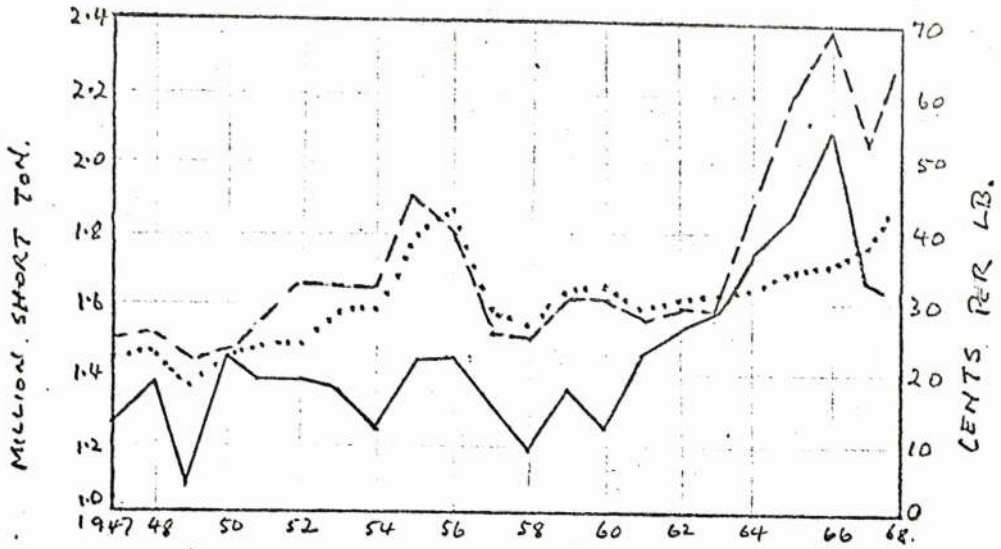
demand could spill over to other international copper markets. Indeed the Comex is so narrow that it is usually forced to sell its copper at LME prices, which are consistently higher than Comex prices (see attached graph).

This brief narrative of the multiplicity of the copper markets of the world shows that it is impossible to speak meaningfully of an integrated world copper market. Both the supply and demand sides of the world copper output are fragmented into several portions. Indeed in some cases these market portions are insulated from the free operation of market forces. This is true of countries like France, Italy and Japan. Moreover, sometimes governments may intervene in the domestic economy, as did the U.S.Government in 1967 when producers there were not allowed, by threat of a dumping government policy, to raise the price of the product beyond a certain level. (The recommended price was in the range 30 to 40 cents per lb., equivalent to the Zambian price of £304-£320 per ton. The average producer price elsewhere was around £400 per ton).

In spite of government restrictions and the practices of selling direct to consumers, the LME plays a central role in the determination of the general level of copper prices. A closer examination of this market will show how.

After the war the LME was re-established in 1954 as a definite response to the metal marketing and price fluctuations problem.(6) Its functions, briefly stated, are mainly to facilitate trade in metals. For this purpose two types of pricing are used in the specific case of copper. There is the "spot price" and the three-months' contract or "forward" price. The idea of a forward or contract price which is fixed periodically, is to attempt to ensure stable earnings for the producer and a steady consumer price over the period. Besides, hedging facilities are also provided so that, for instance, consumers are protected against sudden changes in stock prices, etc. The market attempts to be independent though not necessarily a disinterested

LME & COMEX PRICES.



KEY.

—————— NET CONSUMPTION BY U.S. FABRICATORS

— — — — AVERAGE ELECTROLYTIC PRICE LONDON (EQUIVALENT)

. . . . . . AVERAGE ELECTROLYTIC PRICE NEW YORK.

SOURCE : REPRODUCED FROM THE MINING JOURNAL | AUG. 30, 1968. PP. 141-14

arbitrator between, say, the producer and the fabricator.

However, several major copper producers (e.g. Zambia) and indeed some experts have outrightly condemned the very existence of the LME, though, as we point out below, the basis of the argument is largely untenable on economic grounds. The argument runs along the following lines: The contract price system is said to have inherent weaknesses which make the whole system a worthless endeavour. It is pointed out that a terminal market with a specific time period e.g. three monthly quotation, is unlikely to take full account of market influences that are likely to operate beyond the stipulated period, i.e. the quotation simply binds itself to take account of the market influences operating during or within that period only, or, at least, bases the contract price on the view taken of the market behaviour during the quotation period. The contract price, so to speak, excludes any influential factors effective beyond the date quoted. Such a situation, it is concluded, could lead to a state of affairs in which the price used overstated or understated the real demand and supply conditions in the entire copper market.

This position is further confounded by the LME's policy of "no force majeure". Thus the opponents of the Exchange point out, what seems to be obvious, that anything could happen to change the market situation between the time of contract and the time of delivery. And yet the LME price would not be permitted to vary to take into account the effective factors during the contract period.

Moreover the three months for which a price is fixed is regarded as extremely inadequate for purposes of long-term planning on the part of the producers and consumers alike. It is pointed out that the time lag involved in the supply of a metal can be very crucial in determining the long-term price. We are reminded of the fact that it takes three to five years to operate a new mine or even merely to make substantial extensions to existing mines. Thus, if we assume that the expansion of output of copper in this

instance was a function of price, then less of copper output could have been produced had the immediate price been not so attractive. At a later date when demand has lagged behind supply, such an excess supply would imply a rise in unit costs and a fall in profitability as the price would be bound to fall. In other words, had the price been a true reflection of long-run supply and demand conditions this unhealthy situation would not have arisen. Similarly if the immediate price were low, producers would not forecast capacity expansion but only to find that at that later date demand had overrun supply, implying a rise in prices and producer profits to the discomfiture of consumers.

This argument boils down to the observation that an LME contractural price could lead to disastrous results if it encouraged undue expansion of future output, and, conversely that it could lead to serious shortages in the supply of future output if it was thought by the producers that future prices, on the basis of current prices, would not be so attractive as to justify capacity expansion. This is all because the LME, according to this school of thought, does not take full account of such possible inflexibilities and time lags in supply (and demand).

The "spot price" of the LME appears to be particularly obnoxious to the major copper producers. The point about this price is that it influences the prices at which copper will be sold in markets other than the LME. It also influences the trend of the three months' price quotations. It is noted, for instance, that major copper producing countries like Zambia do not sell their copper on the LME floor, nor, indeed do they engage in hedging transactions on the Exchange. Such countries sell their products direct to their customers.

The spot prices or "daily quotations" are the prices at which the last copper deals on the Exchange floor are dealt. It is these prices that determine the LME's official price for the day. Since 1954, free market copper outside the North American continent and the producer scheme has been priced on this LME daily quotation. Considering that this price appears to

reflect the demand and supply conditions of only about 25% of copper output in the free world, the producers argue that this is really a case of the tail wagging the dog.(7) The price, in short, is regarded not as a true reflection of the actual world supply and demand situation. And it is hardly possible to expect the big producers to take kindly to this system of price-determination.

The outlined argument reveals an inadequate appreciation of the nature and economic function of the LME.

First and foremost the LME is a metal merchants' market. Prices will therefore contain an element of manipulation and not infrequently exaggerated fluctuations. This way merchants are said to make profits at the expense of producers, which is one main reason why large producers dislike the LME and its metal merchants. The producers are quite naturally interested in prices that reflect long-term supply and demand, and are thus not only irritated, but greatly worried by what appears to them to be avoidable and exaggerated short-term price fluctuations.

The LME does not permit contracts for definite or specific brands of copper. It leaves it to the seller to deliver a fulfillment of his contract indiscriminately any one of the registered brands. This is another bitter pill for the producers who have always been anxious to reserve certain areas of the world as their exclusive markets. Thus, through product differentiation, i.e. by creating proprietory brands of copper (e.g. R.E.C. = Rhokana Electrolytic Copper), producers would like and attempt to attach certain customers exclusively to themselves.

So far the LME allows contracts for three kinds of copper. One for "copper wire bars" refers to the electrolytic copper or high conductivity fire refined copper in the form of wire bars of standard dimensions in the weight range 200-275 lbs. The second contract is for "copper cathodes" and refers to the electrolytic copper in the form of cathodes assaying not less than 99.9% copper content. The third contract is for "fire refined copper" of

two classes, either of which the seller has an option to deliver. Class (i) fire refined copper assays not less than 99.88% of copper in the form of ingots or ingot bars at contract prices. Class (ii) is fire refined copper assaying not less than 99.7% of copper in the form of ingots or ingot bars at the price stipulated in the contract less 7% per ton.

Altogether there are, therefore, only four types of copper which one can buy on the LME. However, there has been in recent times, a movement towards increasing the number of copper brands registered on the LME. It is currently being proposed to increase the number by seventeen more brands from Africa, Asia, North and South America.

Meanwhile, the problem of fluctuations on the LME is as yet to be solved. From the point of view of copper sold by merchants on this market, the nature of the supply of this copper seems to spell fluctuations in itself. Prominent sources are, for instance:

Old scrap;
New scrap not self-consumed by fabricators;
Secondary refined copper brought from small or medium custom smelters and reinfers;
Concentrates from small or medium independent mines;
Occasional parcels of excess stocks of fabricates;
Primary and secondary copper from occasional purchases in countries selling copper only intermittently (including Soviet Union).

That is, the varied nature of this source of supply directly or indirectly imparts into the price fixing on the LME a somewhat unhealthy element of fluctuation. This in turn spills over into the rest of the free world copper market, where the main dealers are the big producers.

It is convenient at this point to return to the main theme of this section, i.e. the relationship between the LME and the rest of the copper market of the free world. We submit that a great deal of the allegations against the LME follow from a misconception of the economic function of this market. Admittedly, part of the LME is a speculative market. In this respect it is the only mechanism for taking a view of future prices. Investors with no use for

copper itself can use the market to match their wits for gain against expert dealers, whose expertise and profit consists in part of their "speculative" ability to buy and sell at the right times and prices.

It is also true that the proportion of copper sold on the LME is small. But it must be understood that this amount represents a surplus of supply and of demand which invariably moves the price down or up in a commodity market. It is these very surpluses which are dealt in on the Exchange. In other words the LME is essentially a market for excess supply and demand. Hence, if there is speculation, it must, on the whole, steer prices in the right direction; otherwise it just would not be a paying proposition.

Thus so long as the laws of supply and demand operate in copper, the traders perform a useful economic function. Stabilization schemes should therefore not be aimed at killing the LME, but to build it up by increasing or reducing the turnover, thereby correcting the markets over-sensitivity. The answer to price stability does not lie in rigidly fixed prices, but in raising or lowering copper sales on the free market. Then the "minute turnover" would not have such disproportionate effects on price.

Indeed merely to adopt the LME price does not entirely help to solve this fundamental problem of fluctuations. But there is no doubt that much of the instability will be mitigated. The use of a forward price rather than the cash quotation would create a much more stable situation. The forward price is much less prone to sudden, upsetting sales or purchases. Our own proposal in this respect is two-fold: first to raise stocks necessary to even out fluctuations over the period, and secondly to increase the contract period. Thus if turnover were increased a true forward market would become possible. At present the forward market is used mainly to hedge trading positions, protecting buyers against a shift in price rather than to secure future supplies An increase in stocks need not imply a rise in world stocks; it would merely

mean that a larger proportion would be held in the LME warehouses or on the Continent. Once stocks are registered in these two official warehouses, they can be sold on the Exchange if need arises.

The broadening of the forward market will also be a necessary part of the stabilization policy. In a broadened market fabricators can order actual requirements several months in advance. This means that forward trading would become a far more reliable indicator of underlying changes in demand. On the other hand, producers could then more assuredly adjust output in time, and could damp down fluctuations even further by setting up a buffer stock in copper. If the forward market accurately reflected fabricator demand rather than speculative sentiment, a producer buffer stock in copper could be effectively used against any short-term fluctuations.

This way of looking at the problem shows that the LME, far from being obnoxious is an ally of the producers and that stabilization schemes can only work, in the present nature of circumstances, if the LME were taken into confidence as part of such schemes. This would be true whether the argument applied to scrap or to virgin copper, whose individual prices, as we know, affect each other in varying degrees.

CHAPTER 1

REFERENCES AND FOOTNOTES

1. The main sources for Section I are:

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   C. H. Thompson & H. W.Woodruff in Economic Development in Rhodesia & Nyasaland. (Dennis Dobson Ltd. London) Esp. Chapt. 7.

   R.E. Baldwin in Economic Development & Export Growth. A Study of Northern Rhodesia 1920 - 6) (University of California Press 1966) Esp. Chapts. 2 & 8.

   Barber in the Economy of British Central Africa - This is an extremely profound textbook discussion of the Political Economy of the Federation of Rhodesia and Nyasaland.

2. See e.g. Mining Annual Review, May 1968 pp. 15-23: "Changing Structure of the Industry".

   Also Annual Reports of the two Mining Groups.

3. See Tables and Graphs on Cost Trends, Chapter 3 of this work.

   On Shipping ratios see file MLM/6 - 11, and a relevant discussion is presented in Chapter 3.

4. see R. Perlman's Article in "Management Today", Sept. 1966, pp. 73 and 140.

5. For a discussion of LME and COMEX price trends, see e.g. Mining Journal 30/8/68 pp. 141-142;
   Perlman's article discusses the nature, organisation and effect of these market systems, ibid. esp. pp. 70-73.

6. See e.g. H. R. Frazer's article in "Optima", Dec. 1965.
   The LME had been non-operative since the war.

7. See Perlman's article, ibid. p.73.

CHAPTER 2

MINE TAXATION - AN INTEGRAL PART OF THE SYSTEM OF TAXATION IN ZAMBIA

In the preceding chapter we discussed in brief the relationship between the mining industry and the activities of the economy of Zambia. Much more pertinent to our research project we noted the fact that the mining companies as a whole, i.e. the mining industry, of Zambia is responsible for the country's recurrent revenue of around 60-70% of the total item. We now make a more detailed analysis of the relationship between the mining industry and government budget requirements. The discussion which we present in this chapter highlights the central role mine taxation plays in the country's national development plan.

We also mention, if only briefly, the likely implications of mine taxation on the prospective investment yield of Zambian mines. However, this aspect of mine taxation or the relationship between taxation, mining costs in general and investment productivity is much more fully analysed in subsequent chapters. For the moment we wish principally to discuss mine taxation as an integral part of the system of taxation in Zambia. The framework for this analysis is provided by the plan period of the country's first national development plan which spans the period 1966 to 1970.

The mines of Zambia are subjected to three main forms of taxation, namely the Profits tax, the Export tax and the Royalty.(1) Anticipating a fuller description, analysis and critique of this tax system, we may note in this chapter the various rates at which the taxes are levied. The profits tax is progressive and the liability is 38% for every income up to about £100,000, and 45% for income levels above this operating profit of the company. Export tax or duty is levied progressively too at the rate of 40% of the difference between LME price per ton and a nominal £300, i.e. 40% (LMEP-£300). Royalty is charged per ton of commodity produced

and the rate is also mildly progressive, viz: 13½% of LME price minus £8 (i.e. 13½%P-£8).

Now, any tax on a corporate enterprise is simply a tax for doing business.(2) In the usual case it is a tax on the income of the particular business enterprise, and technically referred to as a corporation tax. The assumption is realistic that any tax is imposed to achieve a purpose or objectives, however non-economic the objectives might seem to be.

Thus when deciding on a system and structures of taxation a government can be presumed to be guided by specific objectives which may be purely fiscal, economic, social or political or indeed a combination of all or some of these objectives. The whole system of taxation is thus geared to achieving such objectives. And the tax structures designed - proportional, progressive, regressive - become simply the expression of the means by which the desired target may be attained. Needless to say that objectives will differ from government to government and country to country so long as there are differences of critical circumstances for the different governments or countries. Thus, in underdeveloped economies with surplus labour, one of the main objectives is to gear taxation to the full employment of these manpower resources, while in advanced economies where capital is the factor generally in relative excess, the emphasis is duly placed on how best to fully utilise this factor. Speaking generally, taxation is an instrument which the government uses to attain a desired pattern of investment allocation and activity.

The general rule is that given the objectives, the primary purpose of taxation is always to raise revenue (the maximum receipt) while not running counter to principles of social justice. This is normally understood to mean a "fair" or "proper" redistribution of wealth and involves an assurance of a long-term economic stability and a maximum use of factors of production. It is this relationship between the objectives and the means to attain them which in fact forms the basic meaning of the theory of public

finance and constitutes the essence of a government budget policy.(3)

If the phenomena of (public) finance are understood in this way, we should find it easier to understand why taxes on corporations or business enterprises find a place in the different tax arrangements in so many countries today. The whole system of taxation becomes not merely an instrument of fiscal policy, but rather of the wider issue of political economy. That is, it has the added significance as an instrument of extra-fiscal policy, and with which instrument the political process which makes the choice in matters of finance is enabled to pronounce their or its objectives. Thus, not only would the use of taxation enable the government to restore the balance of the economic system when there is a glut or shortage of capital or to curb undesired inflationary and deflationary tendencies, but may also be used to achieve economic and social control over production.(4) The government may, for instance, desire to reactivate the production of small and medium-sized undertakings by, say, discouraging the creation of large undertakings which, by their scale of operations, tend to make the operation of competition imperfect, which it may also be desired to remedy.

Now, in theory as well as in practice, certain forms of taxation will be more efficient than others in performing a specific function for the government. In Zambia, whatever the specific objectives for which the three mine taxes (royalty, export duty, profit tax) were intended to achieve individually, the effect of the taxes together is to make their main role that of re-allocating resources from the mining sector to the rest of the economy mainly through public expenditure. (The intended role of the taxes individually is discussed in a later chapter dealing with the rationale and critique of the taxes in question). This is evident from the current development plan, the main feature of which we sketch below.

Meanwhile we can say that the current system of mine taxation in Zambia will be justified by the extent to which it succeeds in performing

the function required of it by the national development plan. That is, a required system of mine taxation is one which is consistent with the overall objectives of the national plan. This means consistency from both the financial and the economic requirements of the plan objectives.

In this chapter our analysis proceeds essentially from the financial point of view of the system of taxation in the context of the plan objectives. The economic analysis and implications especially of the system of mine taxation are presented in a subsequent chapter.

The National Development Plan of Zambia spells out both the economic and financial objectives for the period 1966-1970[5]. The eight main economic (and social) objectives are summarised by the plan as follows:

(i) To diversify the economy so that the copper industry is not the only main employer in the economy and so that a greater proportion of domestic demand is satisfied by domestic production from a large industrial base.

(ii) To increase employment by at least 100,000 jobs during the course of the Plan period.

(iii) To increase average monetary output per head from £61 per annum in 1964 to about £100 per annum in 1970.

(iv) To maintain reasonable price stability.

(v) To minimise the inherited economic imbalance between the urban and rural sectors with a view to raising the capacity of the latter sector for transforming resources into social and economic growth.

(vi) To raise rapidly the general levels of education, as well as develop a wide range of specific technical, administrative, executive, professional and management skills in the population.

(vii) To provide more and better living accommodation as a requisite ingredient of a better standard of living, and to raise the general level of social welfare.

(viii) To develop new communications, sources of energy, transport, and other economic infrastructure for a new economic order.

It is further stated that in order to raise the per capita income (objective iii), given the expected rate of population growth of 3.5% per annum it will be necessary to achieve a real growth rate of about 11% per annum over the period (at 1964 prices).

Another major objective is that of increasing substantially the share of GDP devoted to capital investment. By 1970 it is expected that the level of capital investment will be £113.6 m. composed of £55.1 m. public, and £58.5 m. private investment. This implies a much more active participation of the government in the country's process of economic development. (Cf: During Transitional Development Plan in 1965, capital investment equalled only 20% of GDP).

The total capital investment over the period is also expected to be substantially increased. Thus it is estimated that the total capital investment will amount to £429m. of which £282 m. will be provided by the public sector, and £147 m. will be available from the private sector. The proposed annual rate of government investment over the period 1966-70 is said to represent an increase of more than 100% over the figure for 1965-66, and that it is a very large and ambitious increase which is justified for two reasons: (a) the level of capital investment expressed as a percentage of the Gross Domestic Product has fallen steadily since 1957 (b) in the Zambian context, the public sector must play a leading role in investment and, thereby, give a lead to the private sector which may, for various reasons, not expand as fast as might be desired during the early years of the plan. It is observed that a vigorous investment policy by government is a pre-requisite for

dynamic enterprise, especially when a large percentage of the investment is devoted to establishing the economic infra-structure which promotes the expansion of productive private enterprise. It is also stated that productive investment by government, which constitutes a substantial proportion of the Plan (see Table below) will have the effect of increasing the purchasing power of the population, thus bringing about an expansion of private industry and commercial agriculture by expanding the public and private sectors.

The distribution of this capital investment is as follows:

TABLE 10

TOTAL CAPITAL INVESTMENT

	(a) 1954-64		(b) 1964		(c) 1966-70	
	£m.	%	£m.	%	£m.	%
Public Sector	180.4	42.3	13.2	34.4	281.8	65.7
Private Sector	245.7	57.7	24.9	65.6	147.5	34.3
Total	426.1	100.0	38.1	100.0	429.3	100.0

(a) Source: Central Statistical Office, 1954-64

(b) Independence Year 1964

(c) First National Development Plan, 1966-70.

Source: National Development Plan p.12

From the point of view of public capital investment, this distribution represents an average level of capital investment of approximately £70m. per annum. Capital investment over the period 1954-1964 had averaged only about £18m. per annum - a very poor show compared to the current plan estimates. Moreover, altogether the proposed levels of investment during this Plan period represent an increase of about 390.5% over the last ten years of the colonial period.

The Plan appreciates that capital investment of this magnitude automatically generates a considerable expansion in the recurrent expenses of ministries and departments. Annual recurrent expenditure

for the financial year 1965-66 was £45.3 m. for ministries and services, and £17.1 m. for the servicing of the Public Debt. It is estimated that annual recurrent expenditure for ministries and services will reach approximately £74m. in 1969-70, representing an increase of 62.5% over the period 1965-66 level.

The Table below shows how this recurrent expenditure will be allocated:

TABLE 10.1

RECURRENT EXPENDITURE

	1965-66	1967-68	1969-70	% increase, 1965-66
Ministries and Services	45.3	62.3	74.0	+ 62.5
Public Debt	17.1	19.7	24.5	+ 43.3
	62.4	82.0	98.5	+ 57.8

Source: National Development Plan, p.13

Naturally, the Government is concerned with possible adverse effects resulting from such recurring expenses. Hence different methods are proposed by which increases of this item may be controlled and avoid a wasteful expenditure of capital investment. Control measures will include cost minimisation exercises, the use of outside consultants, and the elimination of overlapping services.

It is against this background that the proposed government revenue estimates have been made in the Plan(6). Firstly, the Plan expects that estimates of domestic resources derived from projections of copper production and prices from 1966-70 will suffice to finance the greater part of the development programme. Thus expenditure on capital account is expected to expand steadily utilising internal resources, including recurrent surpluses and domestic loans, to the fullest.

To the extent that these requirements and expectations will

be satisfied by resources tapped through the tax system the government has considered it necessary that its tax policy will therefore be guided by two main principles, viz:

(a) the broadening of the tax-base in so far as compatible with equity, in order to assure the maximum participation of the population as well as contributing to the national treasury.

(b) examining the existing tax rates and opportunities for new taxes.

The plight of developing countries like Zambia is that the level of expenditure depends largely on the effectiveness of the tax system as expressed in productivity, efficiency, growth and stability. The extent to which the plan objectives will be implemented will depend very much on the economic and administrative capacity of the tax system to marshall the necessary resources. In short, practically everything will depend on the effectiveness of the revenue and expenditure processes of the government budget. In the specific case of Zambia the Plan envisages that the tax potential (theoretically the maximum proportion of the national income which a country can make available for public services by means of taxation) can be raised as a whole over the period 1966-70. Levels of investment proposed are expected to raise government revenue over present figures by about 10% or 15% even assuming no change in the structure of taxation. Such revenue (potential) is, of course, closely linked to the level of copper prices and expected output tonnages. Thus assuming an LME price of £360 per ton, the current tax rates would yield revenue of the order of £70 m. to £95 m. p.a. over the entire Plan period.

However, if necessary, the revenue would be substantially augmented by changes in the tax rate of personal income and the indirect

taxes and duties on certain goods with relatively inelastic demands (e.g. spirits, tobacco, cosmetics, etc.). Ad valorem duties on luxury goods such as jewellery and cosmetics could also be varied to produce the necessary revenue.

Changes in the tax structure are also envisaged with particular reference to income redistribution so that the present income and wage differentials between lower and higher income brackets may be narrowed. In this connection it may be necessary to reduce taxes on essential goods and services; in some cases negative taxes or subsidies may be made by the state to enterprises providing essential and staple foodstuffs. The general policy is to raise the purchasing power of the people currently in the lower income brackets relative to the better paid or higher income section of the community. Coupled with a definite government wages policy for the country, this tax policy is expected to yield the desired pattern of income distribution during the plan period.

In case income redistribution should create destabilizing influences in the economy, i.e. create undesirable inflationary processes as a result of a relative increase or rise in domestic demand, counter or stabilization measures are also envisaged in the plan. Generally speaking, in advanced economies undesirable inflation could be curbed not only by means of a system of taxation, but also and usually in combination with appropriate measures of the central bank. But since the money market is still undeveloped and the relationship between the central and the commercial banks is still tenuous, the only effective instrument available for stabilisation in Zambia is taxation. In this respect the Government of Zambia believes that the extent to which taxation will be effective will depend, inter alia, upon:

(a) the widest application of direct taxation to the economic activity of the country.

(b) the technical features of taxes (rate-structure, progression, assessment, procedure, collection and administrative competency).

These measures together with others, ensure that the economic objectives of the Plan are as far as possible consistent and attainable. That is to ensure the realisation of the desired relationship between revenue and expenditure of the Plan.

The Table below shows the various sources of recurrent revenue required to meet the objectives of the Plan during the entire period.

TABLE 10.2

RECURRENT REVENUE

Total Recurrent Revenue, 1965-66, Projections for 1966-67 to 1969-70

(Current Prices) (£m)

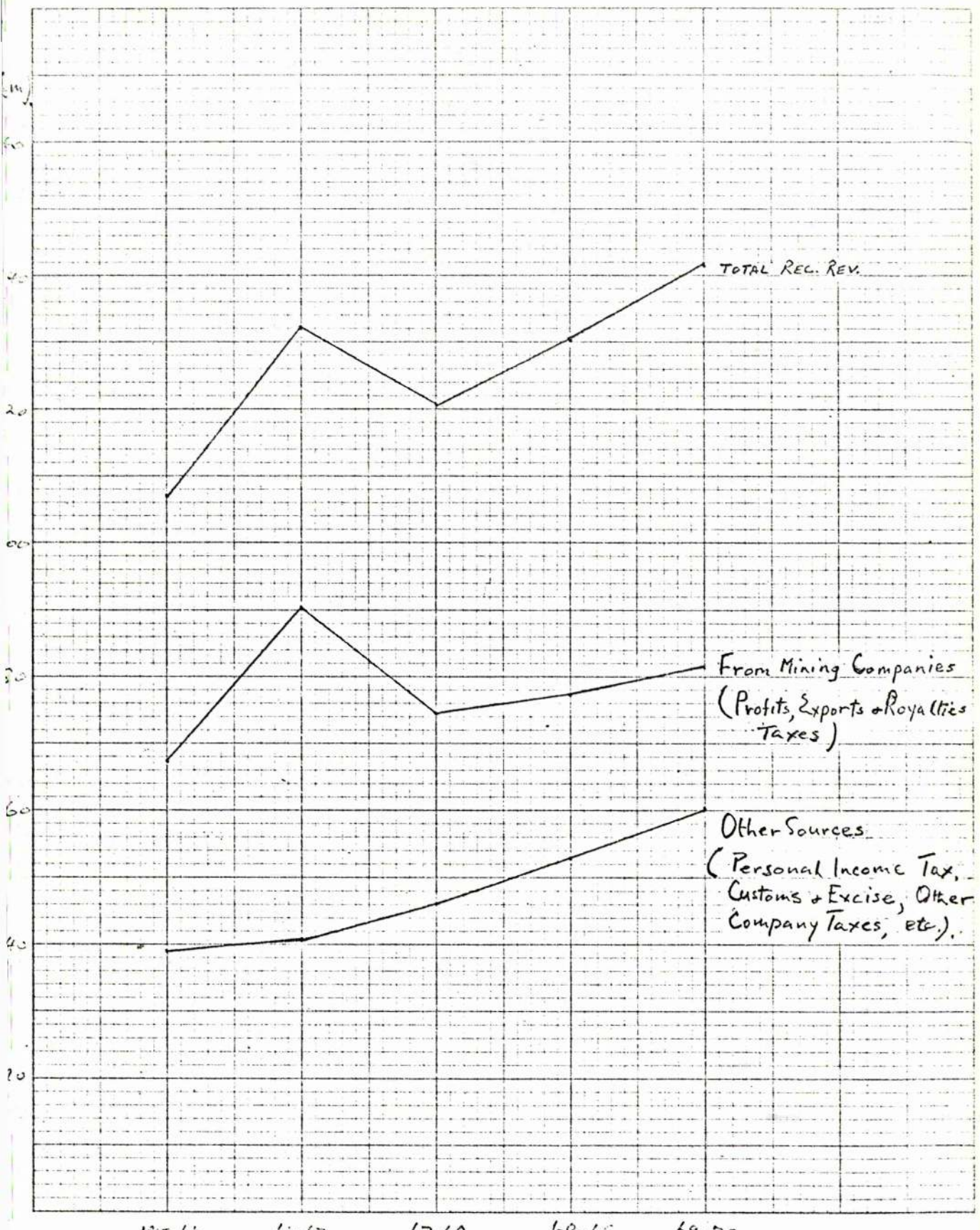
	1965-66	1966-67	1967-68	1968-69	1969-70	Total 1966-70
Income Tax						
(a) Copper Cos.(3)	26.5	32.2	31.3	32.6	34.3	130.4
(b) Personal and Other Cos. (1)	13.5	11.5	13.4	15.6	18.3	58.8
Customs & Excise (2)	12.4	13.4	15.2	17.5	19.8	65.9
Mineral Resources and export Taxes (3)	41.2	58.2	43.3	45.0	47.4	193.9
Other (1)	13.4	15.7	17.5	19.6	22.0	74.8
Total	107.0	132.0	120.7	130.3	141.8	523.8

(1) Related to O.N.D.P. projections of high level incomes and companies profits. Assumes price increases of 4% p.a.

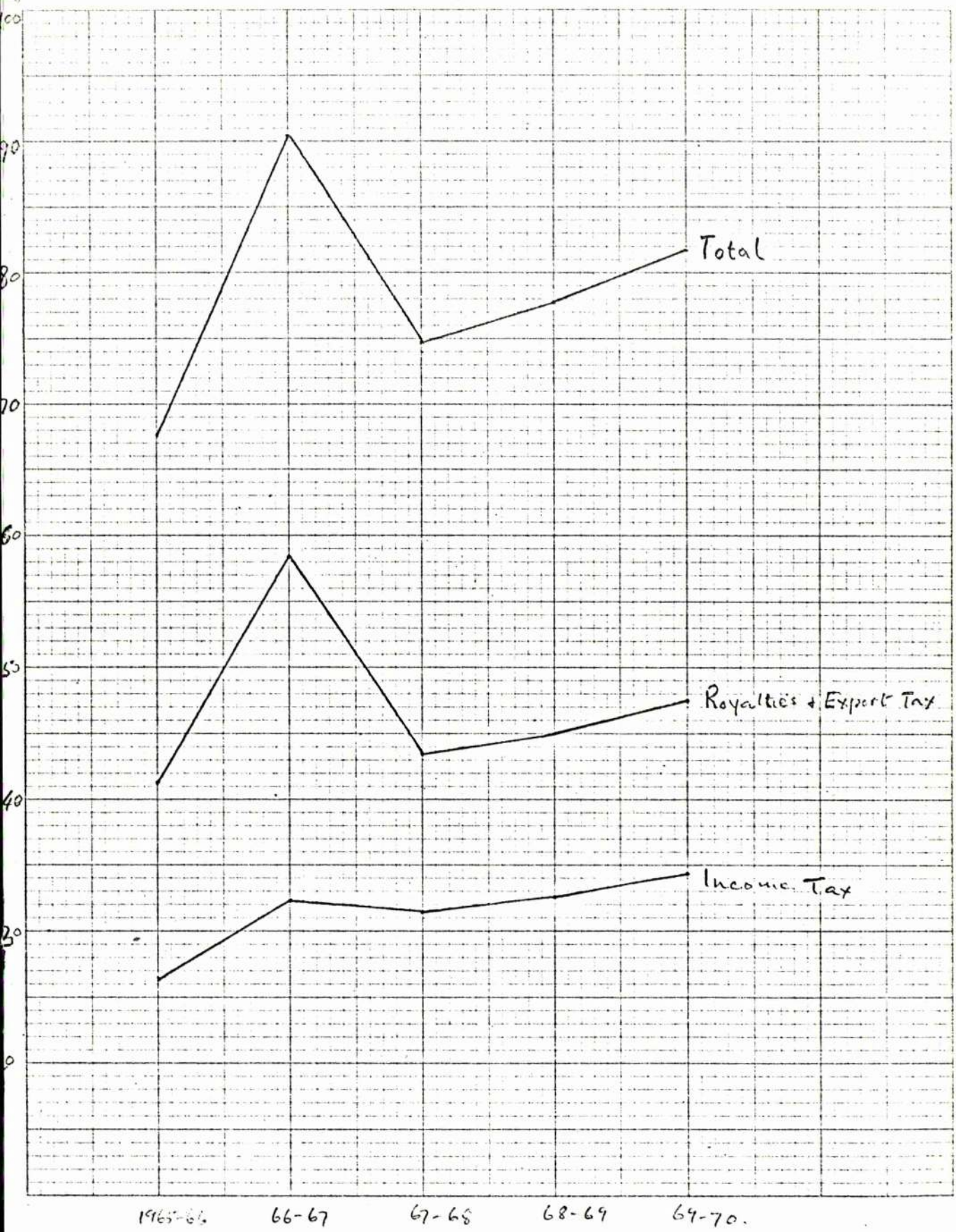
(2) Assumes imports price increase by 2% p.a., duties being levied ad valorem.

(3) Assumption of copper projection:

TOTAL RECURRENT REVENUE 1966-70 ESTIMATES



Recurrent Revenues From Mining Companies, 1966-70 Estimates.



	1966-67	1967-68	1968-69	1969-70
Output ('000) tons	700	730	760	800
LME Price per ton (£)	400	350	350	350
Producer Selling Price £/ton (Wire bars)	370	335	335	335

(a) Royalty and Export Tax rates are assumed unchanged

(b) Income Tax is assumed to be 43.6% of gross profits after royalties and export tax (a lower rate is to be paid by Bancroft on the new mines). In other respects these estimates have been prepared on aggregative industry basis and are currently under revision mine by mine.

(c) All revenue is assumed to accrue in the year of output; lags are ignored

(d) Average mining, operating and transport costs are £153 per ton in 1965-66. rising to between £171 and £182 in 1970.

Source: National Development Plan, p.14.

Our particular interest in this Table is the amount of resources which the mining companies, through the various taxes imposed on them, contribute to the total recurrent revenue. A graphic presentation of these various sources of recurrent revenue easily shows that the most important source of this revenue are the mining companies. A simple calculation from this table shows that at no time during the Plan period will recurrent revenue from the mines fall below 58% of the total recurrent revenue; in fact the lowest point is reached during 1969-70, when the percentage contribution from this source is around 58%. This should not come as a surprise since towards the end of the Plan period one must expect either that other sources of revenue have increased their share of the total or that as the Plan execution is getting to completion, the overall expenditure will tend to fall in comparison to earlier phases, and this means that recurrent revenue will fall in response to this relative lull in the development of the economy. From readings in the Table above it seems, however, that the relative decline of this source of revenue between 1969-70 will be

due to relative increases in the contribution of other sources.

At the very highest point, contribution from the mining companies is estimated to be about 70% of total recurrent revenue, during the Plan period 1966-67.

From what we know and said of the structure of mine taxation, there are three major sources of government revenue, i.e. the Income or Profits tax, and the Royalties and Export taxes. The last two are usually banded together so that we can talk of only two major items of revenue from the mines. A brief analysis of the Table will give us some idea of the significance of each tax component from the mines, for each level of recurrent revenue which the mines must contribute to the treasury. Again, we may do this by referring to the relevant graph attached. On the graph, we can easily see how each item compares to the other.

Again, a simple calculation will enable us to form an impression of the relative significance of each item. Thus, at the very highest level during the Plan period, Royalty and Export taxes would together make up no less than 64% of total revenue from the mines during 1966-67. The lowest point would be 58% during 1969-70.

From these observations on the recurrent revenue sources we can say at least two things: the first is that government revenue is going to rely very heavily on sources from the mining companies for the entire plan period. Secondly, Royalties and Export taxes are going to be the most significant sources of revenue from the mines. For a contribution of around a third of the total during the entire period income tax from the mines will be comparatively less decisive though of course it will for the whole period be as indispensable as any other source of recurrent revenue.

Recurrent revenue is only one item of resource required to meet the development objectives set out for the whole Plan period. It

is quite clear, as the Table below shows, that without other sources of resources, recurrent revenues alone would be inadequate for the requirements of the Plan. Once again a quick impression can be had by looking at the relevant graph attached which indicates the relationship between expenditure, recurrent revenue, and other sources of development finance for the entire plan period

TABLE 10.3

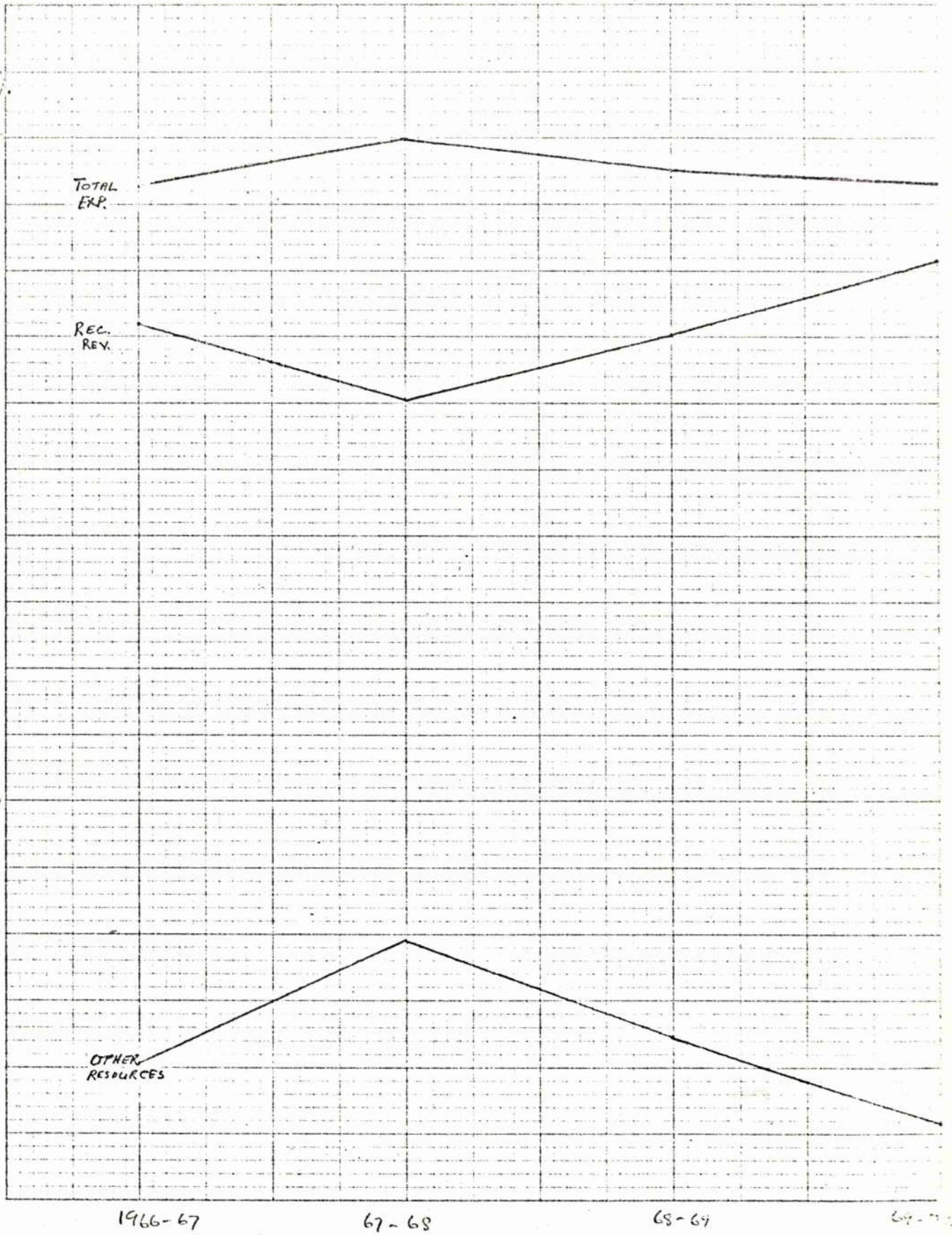
EXPENDITURE AND RESOURCE BALANCE (£m)

	1966-67	1967-68	1968-69	1969-70	Total
A. Expenditure					
(i) Capital Investment	79.5	77.0	70.4	54.9	281.8
(ii) Recurrent Expenditure	73.2	82.9	84.4	98.5	339.0
Total Expenditure	152.7	159.9	154.8	153.4	620.8
B. Revenue					
Recurrent	132.0	120.7	130.3	141.8	524.8
Domestic Loans	5.0	8.0	9.0	8.0	30.0
Self-financing	-	-	1.0	2.0	3.0
C. Loans and Aid:					
External Loans	14.3	29.8	12.3	1.6	58.0
External Aid	1.4	1.4	2.2	-	5.0
Total Resources	152.7	159.9	154.8	153.4	620.8

Source: National Development Plan, p.15

This Table is also reproduced in graphic form to enable us once more to form a quick impression of the significance of the various items we are analysing. The first point we wish to make is the relationship between total resources and total recurrent revenue. It is quite clear that the major sources of development finance will be recurrent revenue. At no point during the plan period will the percentage contribution of this item be less than 72% of the total resources. This is the estimate for the period 1966-67. During 1969-70 this item will alone account for

TOTAL RESOURCES : EXPENDITURE VS. RESOURCES 1966-1970 ESTIMATES



about 90% of total resources required to achieve the development objectives as expressed by the total level of estimated expenditure (capital investment and recurrent expenditure).

If recurrent revenue is so important in the execution of the plan objectives, and we have seen that a greater proportion of this item is made up of revenues from the mines, then quite simply we can say that the development prospects of the economy of Zambia are bound up with the development prospects of that country's mining industry. This, of course, is a point of commonplace knowledge to anyone who knows anything about the economic structure of Zambia. What is perhaps not so commonly known is the exact tax structure that makes the mining industry or the companies the important revenue contributors that they are, and the probable effects of that tax structure on the future development of the industry.

From the point of view of the mining industry we have seen that royalties and the export duty comprise the largest item of taxation. That is to say, the dominance of the mining industry in the economy or in respect of the development plan, is largely due to this dual item of tax revenue. This observation means that the envisaged or desired reform of mine taxation will be of major concern to both the government and the industry, and that in effect the concern will be about the desired role of royalties and export tax in the financing of the development plan objectives.

Now, given the economic objectives and the level of revenues required to achieve these objectives, any reform of taxation will imply either a change in the structure of mine taxation, leaving the amount of tax revenues from the mines constant, or a change in the amount of tax revenues from the mines corresponding to changes in tax revenues from the rest of the economy. The necessary condition to be satisfied

in this case is the balance or equilibrium between revenues and expenditure, i.e. if the development objectives are to be realised the equilibrium between revenue and expenditure must be maintained in one form or another.

However, from the point of view of the economic effects of taxation on the taxpayer (i.e. the mining industry), not only the amount but also the way in which the tax is levied (and spent) is critical in determining the desirability of a given system of taxation. Thus, given the development objectives of the government and the amount of revenues required from the mining industry, the two sides, i.e. the government and the industry may still have to argue about the rationality or justification for choosing a particular tax structure instead of another which would achieve the same amount of tax revenues in accordance with the plan requirements. Given government policy for the mines, the argument will essentially be about the incentive effects on production, and the consequent effects of the tax on prospective investment from both the domestic and especially the international economy from which a considerable proportion of mine development finance comes.

Thus, the current quest of the mines for a new system of taxation involving a change in the nature of the royalty tax is based largely on considerations of costs and their presumed effect on incentive to expand production and investment activities. The mining companies hold the view that if the present system of royalty payments, for instance, was modified or even radically changed the industry would be less constrained in their production possibilities. In effect, the whole argument is based on comparative cost analysis and on the observation that the present system of royalty taxation appears to be out of touch with changing economic parameters. At this level of the argument, as well as the way in which the tax is levied, the share of

revenue from mine taxes is no longer data. It is pointed out that this need not create an imbalance between the desired total revenues and expenditure. Thus a redistribution of the tax liability throughout the economy would ensure that the possible imbalance did not occur. Indeed a case is made for the mine tax liability to be redistributed within the mining industry itself. We discuss these and related issues more fully later and constitute a major aspect of our thesis.

For the moment we may observe briefly the relationship and implications of the taxes in question vis-a-vis the mining costs of this industry. We do not, however, presume that the level of taxes is independent of all other items of cost (including profits). The relationship between costs and taxation as a cost is always indeterminate in practice since one form of cost will normally effect the other. Hence, the following brief analysis is only a first approximation:

The average production cost for Zambian mines was £215/LT, for an average LME price (P) of £350 per ton sold, in 1967 (7). Thus, given the royalty (R), export duty (ET) and income tax (IT), we can analyse the issue as follows:

For P = £350/LT

R = £47

ET = £13

IT = £30

That is, the additional cost for producing and selling a ton of copper at £350 is equal to the amount of royalties plus the export tax levied per ton. In our example, this equals £60/LT altogether, so that the total cost of production and sales will be

Production Cost	=	£215/LT
Royalties and Export Tax	=	£ 60/LT
Total	=	£275/LT

Gross profit is therefore equal to £75 per ton, which, when reduced by the income tax (£30) [8] results in a net profit of about £45/LT. Expressed as a return on capital this represents a rate of yield of less than 15% for the Zambian industry (see Chapter 3, Section 4 of this work). On the basis of this observation, the mines argue that for a production cost of £215/LT, at the prevailing level of prices, a much more moderate system of mine taxation would be desirable as this would bring about a healthier level of profitability consistent with a policy of industrial expansion.

There is clearly a conflict of interest here. In the first place, notice that under these conditions, the yield of government revenue is altogether equal to £90/LT, representing more than two-thirds of the total gross profits of the mines before taxation of any form. Naturally, exponents of the industry question whether this tax liability on the mines is also consistent with government mining policy, and, as stated above, whether in certain circumstances it would not be more rational to redistribute the nature of the liability within the mining industry, or throughout the economy as a whole.

We make much of this point because once we have accepted the fact that Zambia's mining industry is the back-bone of the economy, we must then look to the factors that determine the well-being of that industry. Since the industry is an export sector we are naturally interested in the factors that bear on this industry on its ability to compete in the international market. This means that we must attempt to show how well the standing of the mining companies of Zambia is vis-a-vis the competing companies in the world economy. A comparative cost study is invaluable in this respect. It is important from our stand-point since it enables us to form an opinion on the extent to which the projected sales of copper embodied

in the development plan may be realised. It cannot be too often said that success of the Zambian mining industry in the international economy is a primary requirement towards the fulfilment of the goals of development as set out in the national plan for Zambia as a whole.

CHAPTER 2

REFERENCES AND FOOTNOTES.

1. See: Chapter 4 of this study.

2. See: G. Colm in A.E.Review, Papers and Proceedings, 1954- "Corporate Taxation", also his "Essays in Public Finance and Fiscal Policy" Oxford University Press, 1955, essay 5, original edition of 1954, pp.90-95.

3. See: R.A. Musgrave in "The Theory of Public Finance" McGraw-Hill Book Company, Inc., pp.7-258, et al.

4. See: O.E.C.D. Report of 1959, by Professor Cosciani on the effects of taxation on producing enterprises, especially Chapter 4.

5. See: The National Development Plan, 1966-70, pp.5-8.

6. See: The National Development Plan, op. cit. - Financial Statement, pp.11-15.

7. See: Chapter 3 of this study for a more detailed account of the relationships between production, cost, and the price of copper.

8. The Profits tax is progressive, and will be relevant only where a company makes an overall net profit of more than £100,000.

CHAPTER 3

MINE TAXATION AND MINING COSTS

In the concluding pages of Chapter 2 we attempted to indicate that given the cost structure of a mining company, per ton of metal produced, certain cost items accounted for a considerable proportion of total costs of production and sales. In this instance we isolated the royalty and the export duty as particularly significant. The discussion which we make now is thus an elaboration of this observation. We are particularly concerned with how the system of taxation relates to other mining costs of the mining companies of Zambia and how all this must affect the entire industry in its performance vis-a-vis competitors in the international market. We have said it several times earlier why a favourable comparative cost for the mining industry of Zambia is an important condition in the attainment of the objectives and goals of development as set out in the plan for the period 1966-70. That is, what happens to this industry determines effectively what the development tempo of the whole economy will be. And what the development tempo of this industry will be depends almost entirely on how competitive it is in the international economy. Having said this we are back to the question of production and sales costs which we propose to describe and analyse here as follows:

Section 1: Mine - Definition and Essence (1)

In order to comprehend more fully the meaning of mining costs it is necessary first to understand the meaning of what the activity and structure of mining is all about. However, in this section we present only a brief, but adequate for our purpose, description of what the enterprise of mining involves.

In general, mining is the process by which mineral values are won from the earth's crust, or, put differently, an artificial excavation

or extraction made from the earth's crust for the purpose of winning mineral values is called mining. Defined thus, mining therefore includes both open-pit and underground excavations for metal and coal workings, quarries and oil, gas, salt and sulphur wells, but excludes burrow pits, railway sewer and water tunnels and, in general, all diggings made for commercial purposes other than the exploitation of minerals.

A mineral deposit may be worked for a profit or for other reasons. Particularly in the Western economies the idea or concept of economic value is central to any decision relating to a business venture. In countries like the U.S.S.R., however, it is not always the decisive indicator that a venture be profitable before it can be undertaken.(2) More often than not, considerations other than profit are more important. Thus mining may be undertaken simply for strategic reasons even though it may not be immediately profitable to operate it. Moreover, even in the Western capitalist countries, war time or contingency planning does necessitate undertaking operations of enterprises which may not normally be regarded as economic.

The economically mineable mineral-bearing deposit is technically called "ore".(3) Thus without change of grade or location what is "mineral-bearing material" at one time may become "ore" at another through the development of cheaper extraction processes or because of changes in one or more of the factors entering into the cost and sale of production. This would lengthen the life of a mine and the reverse is also true. Hence the fact that mining, at least in the West, is understood to mean the extraction of mineral materials for a profit, or as "the art of making money out of ore". Thus, unless a mineral deposit can be worked at a profit it remains nothing more than a prospect.

The nature of <u>ore</u> itself has been defined as "the natural aggregation of one or more minerals from which useful metals may be profitably extracted".(

As we have just said, this profitable natural aggregation of minerals is determined by the relationship between the cost of production and the market price per unit. That is, this cost-price relationship established the grade of material at which profit can be realised. Material of a grade above this dividing line or assay cut-off is what is known as ore; material below the line is simply not ore, since it is not profitable to mine it under the technical and economic conditions current or forecast. Thus the standard or accepted classification of ore is as follows:-

Proved or Assured Ore

This is defined to cover principally the ore blocked out in three dimensions by actual underground mining operations and drill holes, where geological factors which limit the ore body are definitely known and where the chance of failure of the ore to reach these limits is so remote as not to be a factor in the practical planning of mine operations.

Semi-Proven

This covers all the ore that can be reasonably estimated to exist; or the extensions of proved ore near at hand, where the conditions are such that ore will almost certainly be found but where the extent and limiting conditions cannot be as precisely defined as in the case of proved ore.

Prospective or Possible Ore

This occurs where the relationship of the land to adjacent ore bodies and to geological structure warrants the presumption that ore will be found but where the lack of exploration and development data precludes anything like certainty of its actual location or extent. It can only be estimated as "small" or "large".

The fourth category of ore may be said to include all blocks of low grade ore that can be mined out in order to obtain access to richer portions of the ore blocks. This category is sometimes called "unprofitable sections". But then in the terminology of the economics of mining an

unprofitable ore is not ore; it is simply waste rock, at least at the prevailing cost-price relations.

Parallel definitional terms are also given in the literature. These are: Measured Ore, Indicated Ore and Inferred Ore. These purport to be more exact in determining the different ore categories in an attempt to minimise problems of estimation and valuation of ore. In both systems, however, the actual estimates will largely depend on the type of deposit - whether rich or spotty, or uniform in content; also upon the number of visible sides of the block and upon the size of the block relative to the openings from which it is viewed.

Thus the term ore reserves embraces all the quantities of minerals that can be reasonably assumed to exist. These are estimated and defined in relation to existing technology and the prevailing economic conditions. This means that the concept does not define a static or fixed relationship. That is, as technology and economic conditions change, the tonnage (and value) of ore that can be profitably exploited also changes.

The significance of ore classification must be self-evident. Mining is one of the riskiest ventures in the commercial world. It is therefore of utmost importance to the prospective mine operator that the estimates fall within reasonable margins of error. In the first place his decision to undertake any such venture will depend on the prospective yield of his investment, i.e. the marginal efficiency of his capital outlay. Secondly, whether he succeeds or fails will depend on the reliability of the estimates, among other things, of the ore in the ground. Indeed, mine valuation poses as the most challenging task facing the mining engineer. Mines, whatever their ultimate value, must begin as prospects. It is on these prospects, once valuated, that a decision to invest must be taken, that a venture succeeds or fails. It may be said, for this reason, that the fate of the prospective mine operator lies largely in the hands of the mine engineer or valuator.

Mineral production in general, copper production in particular, is an entrepreneurial activity which embraces several processes, one of which - extraction or excavation - we have already noted. Thus the final product or metal results from the treatment of ore at various stages of the production plant. Such stages are, for instance, the concentrators, smelters, refineries, and, for specific requirements, semi- and final fabricators. Copper scraps may also be regarded as a stage of production, at least to the extent that this is a source of supply of the metal.

(i) Mines or Concentrators

These produce ores and concentrates which are either exported or sold to smelters but which can also be imported by smelters or by merchants (who would subsequently send them to smelters, or order them to be smelted on toll). Merchants would sometimes obtain a small amount of ores from domestic mines. But this is often an uncertain source of supply.

(ii) Smelters

Smelters produce matte, blister, anodes which may be sold to refineries and very occasionally also to merchants. These merchants may re-sell them to domestic refineries or order them to be refined on toll.

(iii) Refineries

These produce electrolytic and fire refined copper which may be exported or sold to fabricators, or very occasionally also to merchants who would subsequently sell it to semi-fabricators to whom they would also sell parts of scrap, especially clean brass.

(iv) Semi-fabricators

These produce wire bars, cathodes etc. (i.e. wrought copper) for export or for selling to final fabricators or to merchants.

(v) Final Copper Fabricators

The final fabricators produce all sorts of copper scraps which they can sell to consumers i.e. real investors and Government; or they can sell their product through merchants to consumers.

(vi) Copper Scrap

This is a special source of copper supply. The total of new and old scrap copper may enter three stages of production i.e. smelters, refineries and semi-fabricating works. It may also be imported.

Production stages are, in practice, not always independent of each other. Vertical integration exists. For instance, in Zambia, the mines, smelters and refineries belong to one controlling group. It might be the R.S.T. or Zam-Anglo groups of mines. In other countries, e.g. U.S.A., integration may go even further to include semi-fabricating plants and final fabricating works.

Moreover, where merchants are agents of producers they too will or may to all intents and purposes, be integrated with the rest of the production stages. Functionally, however, merchants are only intermediaries for primary producers and for the people who actually sell new and old scrap.

The various types of copper output produced at the various stages of the mining plant may be analysed further. Thus, depending on the level of technology of the producers' plant and/or the contract between the producer and the consumer, there will be several types of final copper output. For instance, these may be primary, crude, refined, manufactured, scrap copper, as well as copper alloy.

(i) Primary Copper

We define this as the copper recoverable from copper content of newly mined copper ores. This is produced by copper mines, concentrators,

smelters and refineries from a variety of primary copper materials. The Copper Companies of Zambia export now only primary copper, blister, electrolytic bars, and ingots.

(ii) Crude Copper

This is a product of the mines and smelters. Copper mines produce and may export ores, cuprous pyrites, concentrates (30% copper content), copper precipitates (cement copper with 70% to 80% copper content), blister cake, etc.

(iii) Refined Copper

Refined copper is the product of furnace refineries which produce fire-refined or casting copper and anodes. Electrolytic refineries produce cathodes.

The scraps produced by refineries comprise bars, cakes, billets, ingots, ingot bars, cathodes, copper powders, etc. and are referred to as UNWROUGHT copper.

The semi-fabricators of copper produce wirebars, tubes, pipes, special shapes (made by extrusion or drawing), flat products as well as copper powder, etc. All these scraps are referred to as WROUGHT copper.

(iv) Manufactured Copper

Both unwrought and wrought copper are unmanufactured copper. Manufactured copper consists of intermediate or end products of manufacturers or fabricators of copper products.

(v) Scrap Copper

(a) New Scrap

This is the waste product which enters in the course of producing semi-finished and finished copper fabricates.

(b) Old Scrap

Old copper scrap consists of copper fabricates which have reached the end of their useful lives.

Old and new scrap is refined in either primary smelters or in those refineries specialising in conversion of scrap. These are known as secondary smelters and refineries.

A scrap producing country may either retain or export the scrap i.e. other countries may import the scrap. Moreover, countries with secondary smelters and refineries may export matte, blister or refined copper processed from scrap.

(vi) Copper Alloy

(a) "Copper-base" Alloy

A copper-base alloy contains at least 40% in a given unit of admixture of metals.

(b) "Copper-bearing" Alloy

Any copper alloy with less than 40% copper content falls under this head.

The admixture of some less valuable metals is sometimes merely replacing an equivalent amount of copper. To that extent they are substituted for copper. With other copper alloys, the non-copper metal imparts to the alloy some new properties without which the incorporated copper would not have the corresponding demand. Such copper alloys thus represent an additional use for copper and accordingly increase demand for copper. There is at work here the notion of joint demand.

(vii) "Reactivated Copper"

This is normally produced in brass mills and copper mills by concentrating clean copper scrap or copper alloy scrap into semi-finished or finished copper products. In these cases the processing of scrap in smelte and refineries has been by-passed.

This situation gives us two sub-types of secondary copper:-

(a) copper and copper alloy scrap concentrated in smelters and refineries.

(b) reactivated copper or "direct use scrap" i.e. copper and

copper alloy scrap directly converted to semi-finished or finished products in copper and brass mills.

Stages of Production ih Zambia Mines(5)

In Zambia there are only four stages of production. The two fabrication stages as mentioned above do not exist here. There is talk however, that at least a semi-fabrication stage should be established in Zambia. In fact arrangements appear to be already on the way between the Government and the mining groups to establish a fabricating plant as soon as possible. As of now, however, the following are the operating stages.

(i) Mining or Extraction of Ore

This is the stage at which the winning of the ore from the underground workings takes place. In the case of Nchanga mine part of this is won from open-cast workings. At Chambishi, all mining is open-cast.

(ii) Concentrating

This is the stage at which crushing and flotation of ore takes place. In the process the material is liberated from the waste rock and is then made into a concentrate which may contain anything from about 30% to 50% copper.

(iii) Smelting

This process further upgrades copper content per ton of ore. First it produces matte and then blister copper.

(iv) Refining

This is the final stage of copper production ih Zambia. It consists of an electrolytic process which produces the highest degree of purity. The product is then cast into refined copper wire bars and other shapes.

The final product is exported to consumers through Beira, Lourenco Marques, and Libito Bay. Since the Rhodesian U.D.I. some copper has had to be flown to some East African sea ports (e.g. Dar-es-Salaam) for shipment

to European markets. Before U.D.I. the journey to the sea coasts used to take about two weeks. It now takes much longer. The average time to reach the European markets used to be three to four weeks. Again this time period has since increased.

The costs which this transportation time period implied have also been inflated in recent times. Transport costs used to average about £20 per long ton; now they are in the region of £30/LT.(6)

Moreover, because of the distance and the time taken to cover it, transit stock used to vary around 35% of annual stock.(7) This percentage must have risen appreciably also in recent times, and since royalty is payable on output produced, and royalty has the effect of cost, the observed relative increase in production costs for the Zambia mines would appear to be easily explainable.

We discuss this question of costs more systematically in the following section, with special reference to their relationship to the comparative costs of the Zambian mines vis-a-vis other copper mines of the world.

Section 2: MINING COSTS - DEFINITION, CATEGORIES

The earning power of a mine depends not only upon the nature and extent of the natural resources, plant, equipment, and efficiency of operation, but also upon all of the critical economic factors which influence marketing, supply and demand, and the purchasing power of the currency. These factors determine on the one hand the cost of production, and on the other the price at which the product is sold. The difference between the total cost of production and price measures the "profit spread" which can either be positive or negative. A successful business, however, implies that the profit spread is positive, i.e. the price is higher than the cost.

A positive profit spread is what every business enterprise strives to achieve, whether it be a short or long run objective. All this implies,

in the case of a competitive industry such as mining in Zambia, ability to compete in the world metal market. It is a question of producing at, or having a favourable cost-price relation, or, technically, having a comparative cost advantage over competitors.

The mining costs[8] may, in general, be divided into the following categories:

(a) Operating or Working Cost:

This category covers expenses on main operations of severing and raising of mineral values as well as subsequent operations such as pumping and ventilation as the mine deepens. It also includes cost of management specific to these operations, as well as maintenance and repair costs.

It is obvious that these costs will vary according to the conditions of a particular mine. Costs will be comparatively low where there are massive shallow deposits of high grade. Where the deposits are deep-seated, narrow and erratic, the cost will be comparatively high.

In addition to costs relating to physical undertakings, there are beneficiation and administration costs. Such costs would include rates, rents and any mineral royalties.

Sometimes expenditure on preliminary operation or development of a mine is classified under this head. However, for purposes of calculating depletion allowance, expenditure on preliminary work would be treated separate from all those other costs. This is because while all the other costs are essentially current, i.e. related to the day to day operation of the mine, preliminary expenditure, is, in essence, an initial, once for all expenditure. It has a capital value which is equal to that expenditure multiplied by a compound rate of interest assumed appropriate for the purpose. In this respect it is opposite to the calculation of the capital value of direct or variable production capital.

(b) Capital or Investment Cost:

This category may be divided into two subheads:

Depreciation:

This is the rate of capital recoupment over the expected actuarial life of a mine. During the life of the enterprise such capital allowances may partly be used to cover recurring expenditure on necessary replacements. The essence of the concept is that the whole of the initial capital outlay for productive purposes will more or less be redeemed at the end or during the life of the project.

Depletion Allowance:

In essence, this is similar to depreciation allowance. The main difference is that while depreciation refers to the saving of capital expenditure made on capital equipment for productive capacity i.e. capital equipment to produce output, depletion refers strictly to the savings made on original or pre-production expenditure. In the case where productive property changes hands, the present owner is entitled to an annual depletion allowance valued in relation to the original price of purchase or capital value of the property.

(c) Full Production Cost

Full production costs are the total costs of production, and are incurred by the industry in supplying its commodity to the community. In the main the costs comprise the following categories:

Operating costs

Investment or Capital Cost

Cost of Company taxation

This category of costs is usually expressed in terms of unit weight of production, say, cost per ton. This measure is regarded as a most important indicator of the level of performance of one firm against another within the industry, or of the industry as a whole between one period

and another. (The measure of "profit spread" is less significant for firms within the industry because it purports to measure performance in terms of an average over a period).

(d) Royalty

Conceptually royalty is a payment for the severance or extraction and use of a mineral (or any other natural) resource. In effect it is simply a form of tax and the operator may be required to make the royalty payment in one of two forms: either on the basis of production, i.e. unit value charge, or on the basis of gross profit or gross value realised i.e. an ad valorem tax or a profits tax respectively. In either case royalty will constitute part of production costs of an enterprise.

The various categories of mining costs can be reduced to two main sub-divisions. We can regard all the costs related directly to production as "Operating or Direct Production Costs". The other sub-divisions may be termed "Capital Cost". Under production costs we would include expenditures on, say, labour, supplies, power, transport, etc. The other category would include expenditure for developing a mine, installing plant, townships and subsequent additions for expansion, etc.

There is of course a definite interdependence or relationship between production and capital costs. Thus capital costs are vital in determining the availability or otherwise of undeveloped ore bodies, and they have influence on production costs to the extent that money may be borrowed for the capital cost and thus create a charge for recurring interest which is chargeable in production costs. One can only add in this connection the fact that capital costs of developing a mine, calculated by reference to capital cost per ton of annual output, are rising throughout the world.

This upward trend of costs is also true of the production costs of the main producers of copper in the world. A table produced at the Copper Conference held in Lusaka in 1967 clearly illustrates this point. It was there

shown that the general trend of costs had moved as follows:

ESTIMATED COPPER PRODUCTION COST TREND

	Average Competitive Net Cost, per lt.
1963 Production	166
1964 do.	178
1965 do.	194

Source: Lusaka Copper Conference, Technical Papers, 1967.

The Conference also produced another table showing the structure of costs of leading copper producers in the world. We also reproduce this table elsewhere in our work (p. 81). We refer to it at this point because it displays certain aspects of costs which are pertinent to the present discussion. Costs are shown not only to be so high for some producers, but also the range between the lowest and the highest cost producers is striking. This is a unique feature so far as the mining industry is concerned. One usually finds that the costs of different mining enterprises do not vary so much.

Happily, however, it is possible to explain not only the causes of a rising cost trend, as we shall see in a subsequent discussion, but also the reasons why the mining costs appear to have varied so widely from one producing country to another. For the present we attempt to provide some explanation for the observed cost structure. Indeed the explanation being offered is general so that similar cases of cost spread might be covered by it.

As we can see from the said table displaying the cost structure, the costs refer to the production of competitive copper only. This is copper produced by all the leading copper producing countries and sold in the free market. In quantitative terms competitive copper refers to the production of metals or minerals in which the tonnage of copper is dominant. But in fact in the range of low costs there will be or expected to be found mines

where copper is produced in conjunction with other metals in equal importance or comparable quantities. As such this twin copper output is known as Co-Product copper.

At mines where copper is a small proportion of the total metal output, it is called By-product copper. As in the case of a co-product copper, the cost attributable to by-product copper will be relatively small, although the copper output itself may add significantly to the total competitive copper. This would consequently modify the cost of producing competitive copper as a whole in some countries more than in others where such modifying influences may not exist.

On the other extreme, the high costs may reflect the fact that there are small mines or remote mines which may in addition have unattractive or poor grade ore. Naturally, these will be costly to operate if only because of transport costs.

In other countries costs may be modified by the fact that the output is protected from competitive forces in the free market. Thus, "managed" prices would ensure that the cost of "Protected" copper was not adverse to the enterprise and as such would therefore not be truly reflected in the distributional chart of copper costs.

All these considerations will modify the cost levels of the different producers of competitive copper. Similarly, they will affect the structure of costs for the leading countries in the production of competitive copper.

The cost of producing competitive copper must be understood with this background. For only when a clear and comparable definition of costs has been made would it be sensible to make a valid comparative cost analysis between various producers. Before we embark on a comparative study of costs of various major copper producers in the free world, let us look at the mining costs in Zambia and the factors influencing those costs during given periods.

Section 3: TOTAL PRODUCTION AND SALES COSTS OF ZAMBIA MINES(9)

For analytical purposes the costs of the mining companies are divided into direct and indirect cost. The direct costs include all expenses incurred from the mines up to delivery to the consumer. The Zambian companies define the term inclusive of the provision for non-expansion capital expenditure. But royalty and export tax are excluded and these latter two charges are treated as indirect costs.

(a) Direct Costs:

In order to simplify our problem of analysis we suggest to examine this aspect of cost with the aid of the tables which we attach and which show every important aspect of mining that contributed to the costs during the period for which we have the figures. The tables, which show all the major mining companies of the Copperbelt, are self-explanatory. The accompanying graphs are most revealing with respect to the trend of total production and costs for each mine, for each mining group, and for the industry as a whole.

In this connection the reports submitted by the mining companies to the Ministry of Mines are particularly informative. These show that taking 1964/65 as the base period, the average direct cost delivered to buyers, per long ton rose from £148.1 to £246.5 for the A.A. Group of mines, and from £149.4 to £208.6 for the R.S.T. Group at the end of the calendar year 1967, i.e. a rise in costs of about 66% and 39% for the respective Groups of mines. The average direct cost for the industry rose from approximately £140 to about £220 per long ton during the period in question. (Actually the figure of £215/LT is normally used for analytical purposes).

In contrast, the A.A. Group experienced much higher costs than the R.S.T. One major explanation for this was that while recoverable copper output fell by 7% for the A.A. Group, it actually rose by the same percentage for the R.S.T. Group. Thus, given fixed costs, this decline in output meant for the

A. A. GROUP.

BANCROFT

	1964/1965.					1965/1966					1966/1967.			
QUARTER ENDED	SEPT. '64	DEC. '64	MAR. '65	JUN. '65	64/65	SEPT. '65	DEC. '65	MAR. '66	JUN. '66	65/66	SEPT. '66	DEC. '66	MAR. '67	66/67. (TO DATE)
FINISHED PRODUCTION LONG TONS.	7044	7850	9302	9506	33702	8532	9601	8901	9174	36208	8917	7385	7304	23606
COST OF FINISHED PRODUCTION £'s/LONG TON.														
MINING	110.67	112.03	106.90	99.99	106.93	110.27	100.51	117.21	92.59	104.91	102.27	141.39	149.05	129.00
CONCENTRATING	18.70	18.14	15.22	28.91	20.49	16.82	14.91	17.22	15.13	15.98	17.84	21.32	23.08	20.55
SMELTING & CASTING	16.23	16.54	17.68	17.95	17.19	20.44	18.54	22.50	16.74	19.50	17.04	18.69	20.26	18.55
MINE GEN. EXPENSES	67.53	57.55	50.77	48.19	55.22	58.90	53.78	65.59	63.51	60.36	62.19	86.93	89.84	78.48
REPLACEMENT PROVISION	45.00	45.00	45.00	45.90	45.26	45.90	45.90	45.90	32.00	42.36	32.00	32.00	32.00	32.00
TRANSPORT (TO PORT)	15.88	16.00	16.20	15.95	16.01	16.14	16.02	17.72	19.20	17.27	22.45	23.47	25.53	23.72
PORT HANDLING & FREIGHT	6.04	5.89	6.22	6.20	6.10	6.27	6.23	6.25	6.87	6.41	6.73	23.47	6.33	6.75
REFINING & CASTING.	10.68	10.52	8.82	7.82	9.32	9.51	8.28	9.53	8.99	9.06	10.10	41.44	19.81	13.52
ADMIN. & SALES.	11.21	10.16	9.09	4.84	8.58	5.27	4.80	5.09	6.00	5.28	6.13	6.94	6.97	6.46
TOTAL	301.94	292.23	275.90	275.75	285.10	289.52	268.97	307.01	261.03	281.13	276.75	349.38	372.87	329.03

MAIN FACTORS AFFECTING COSTS IN THE LAST YEAR

WORK STOPPAGE — SHORTAGE OF FUEL

RESTRICTION ON BLASTING

A. A. GROUP

RHODESIANA.

	1964/1965					1965/1966					1966/1967.			
QUARTER ENDED	SEPT. '64	DEC. '64	MAR. '65	JUN. '65	64/65.	SEPT. '65	DEC. '65	MAR. '66	JUN. '66	65/66	SEPT. '66	DEC. '66	MAR. '67.	'67 TO DATE
FINISHED PRODUCTION LONG TON.	22197	25348	26777	25675	99997	24954	24992	23723	22923	96592	21791	18692	18479	58962
COST OF FINISHED PRODUCTION £'s/LONG TON.														
MINING	67.82	63.09	59.95	63.84	63.49	69.22	71.75	79.97	78.38	74.69	87.28	110.92	116.54	103.94
ON CONCENTRATING	12.20	11.45	11.23	11.04	11.45	11.29	11.22	12.29	13.34	12.00	14.04	16.71	17.00	15.82
SMELTING & CASTING	6.16	5.72	5.42	4.81	5.50	5.38	5.34	6.41	5.21	5.58	6.50	9.81	10.67	8.85
REFINING & CASTING	11.10	10.97	10.13	10.32	10.60	10.08	9.47	9.99	9.77	9.83	11.06	12.78	17.27	13.55
ING GENERAL EXPENSES	32.10	25.31	25.06	28.00	27.44	30.32	32.31	33.61	37.21	33.28	32.71	44.06	45.85	40.42
PLACEMENT PROVISION	11.27	11.41	10.78	10.82	11.05	17.54	17.46	17.65	17.30	17.49	28.88	27.53	27.51	28.03
TRANSPORT (TO PORT)	16.05	16.10	16.15	16.10	16.10	16.20	16.20	16.20	16.20	16.20	22.45	23.47	25.53	23.74
PORT HANDLING & FREIGHT	5.31	5.33	6.03	6.15	5.69	6.75	6.53	6.78	6.87	6.73	6.73	7.20	6.33	6.75
ADMIN. & SALES.	6.88	6.13	5.84	6.06	6.20	6.52	6.51	6.91	7.12	6.76	8.00	9.31	9.34	8.83
TOTAL.	168.89	155.51	150.57	157.14	157.52	173.30	176.79	189.81	191.40	182.56	217.65	261.79	276.04	249.93

MAIN FACTORS AFFECTING COSTS IN THE LAST YEAR

WORK STOPPAGE	SHORTAGE OF TRUCKS
RESTRICTION ON BLASTING	LOWER GRADE ORE MINED.

A. A. GROUP.

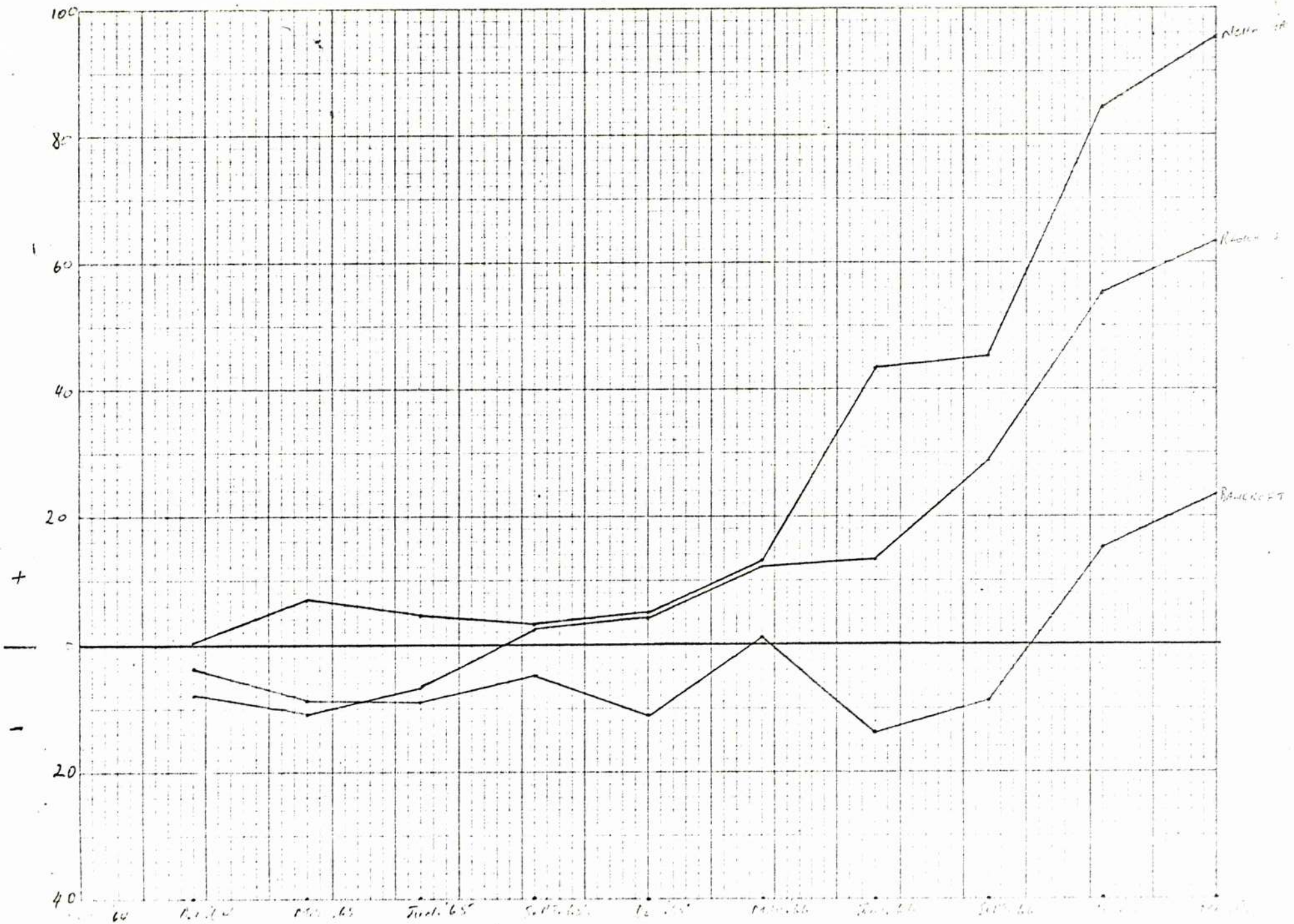
NCHANGA.

	1964/1965					1965/1966					1966/1967.			
QUARTER ENDED	SEPT. '64	DEC. '64	MAR. '65	JUN. '65	64/65	SEPT. '65	DEC. '65	MAR. '66	JUN. '66	65/66.	SEPT. '66	DEC. '66	MAR. 67	66/67 (To date)
FINISHED PRODUCTION LONG TON.	54061	57206	59292	63694	234253	66617	67201	59748	48349	241915	52027	43742	43250	139019
COST OF FINISHED PRODUCTION £'s/LONG TON.														
MINING	26.04	28.35	29.94	29.69	28.58	29.60	31.53	34.89	45.45	34.61	47.70	68.44	64.58	59.48
CONCENTRATING	8.79	10.20	14.56	15.76	12.49	15.51	15.62	17.35	19.56	16.81	19.75	22.93	24.55	22.25
SMELTING, LEACHING, CASTING, & REFINING.	27.85	26.23	28.30	28.94	27.86	27.75	27.14	26.43	31.74	28.05	30.75	40.81	43.89	38.00
CHANGE GENERAL EXPENSES	16.72	16.83	14.86	14.57	15.69	15.28	14.75	19.19	20.86	17.21	19.16	30.25	41.03	29.45
REPLACEMENT PROVISION	15.71	13.87	15.49	11.23	13.99	10.73	12.19	11.50	20.74	13.32	20.70	20.59	20.60	20.63
REPORT (TO PORT)	16.05	16.15	16.25	16.15	16.15	15.87	15.91	17.75	19.20	16.98	22.45	23.47	25.53	23.73
HANDLING & FREIGHT	6.04	6.21	6.59	6.20	6.26	6.27	6.21	6.26	6.87	6.37	6.73	7.20	6.33	6.75
GEN. & SALES	4.08	3.89	3.80	4.27	4.01	4.13	4.10	4.48	9.57	5.29	9.04	10.35	10.41	9.80
TOTAL.	121.28	121.73	129.79	126.81	125.03	125.14	127.45	137.85	173.99	138.64	176.28	224.04	236.92	210.09

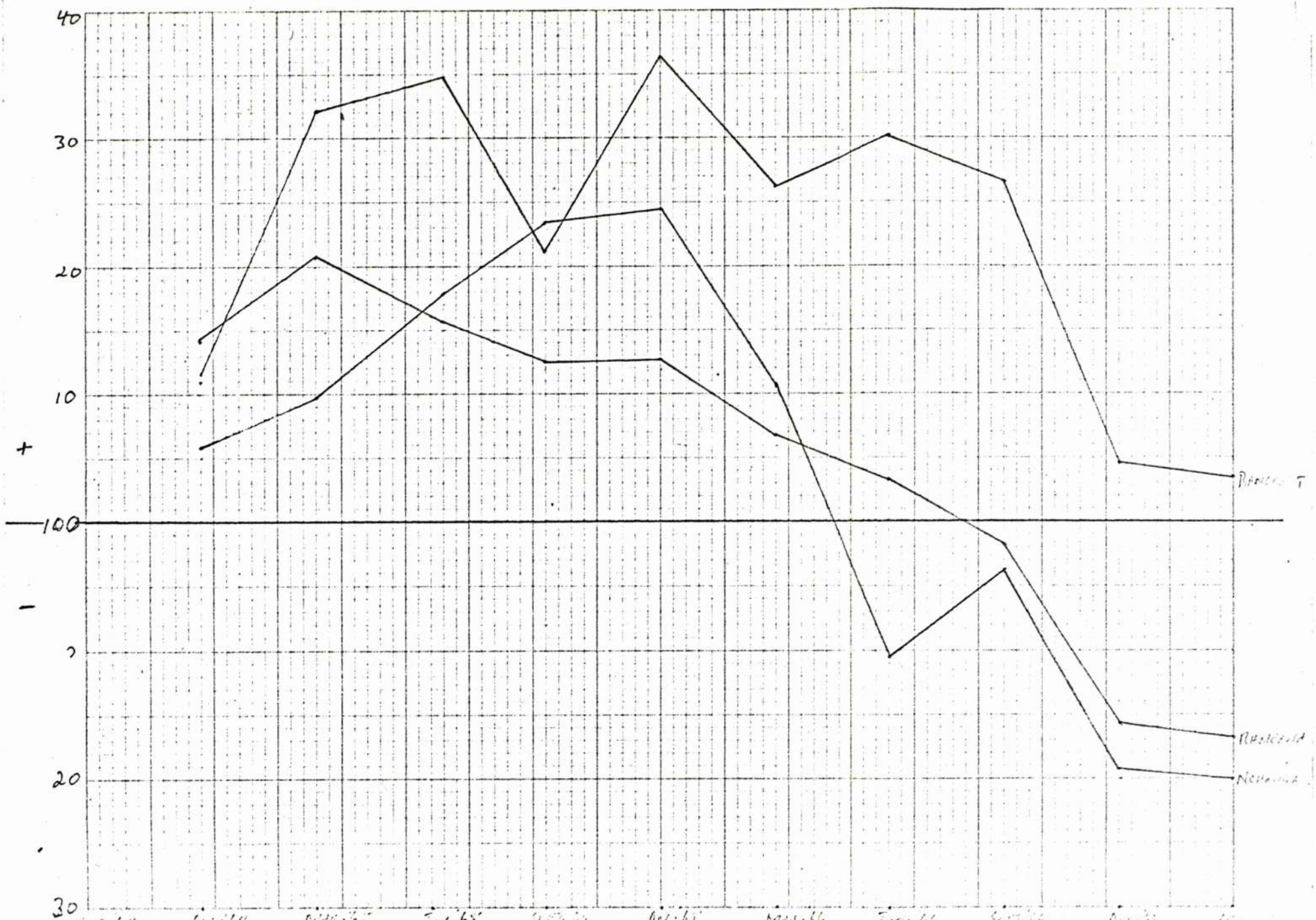
MAIN FACTORS AFFECTING COSTS IN THE LAST YEAR

LABOUR STOPPAGE	SHORTAGE OF [illegible]
RESTRICTIONS ON HEADCOUNT	

COPPER COST TREND % A.A. MINES.



COPPER PRODUCTION TREND % A.A. MINES.



R. S. T. GROUP.

LUANSHYA DIVISION.

	1964/1965					1965/1966.					1966/1967				
QUARTER ENDED.	SEPT. '64	DEC. '64	MAR. '65	JUN. '65	'64/'65	SEPT. '65	DEC. '65	MAR. '66	JUN. '66	65/66	SEPT. '66	DEC. '66	MAR. '67	66/67 (To date)	66/67.
FINISHED PRODUCTION LONG TONS	22449	22549	23146	23848	91992	24563	25133	23843	24061	97600	16243	23611	15449	55305	76940
COST OF FINISHED PRODUCTION: £/LONG TON															
MINING.	74.15	76.96	80.34	81.52	78.31	81.27	82.11	85.52	93.07	85.43	86.19	92.02	98.74	92.19	-
SURFACE ORE TRANSPORT	0.68	0.62	0.69	0.75	0.69	0.77	0.66	0.73	0.92	0.77	0.79	0.84	0.91	0.85	
CONCENTRATING	9.92	9.91	10.23	9.60	9.91	9.27	9.31	9.65	10.77	9.74	9.55	9.77	10.26	9.84	
SMELTING & CASTING	14.01	14.58	14.88	14.02	14.37	12.11	14.03	15.53	18.30	14.97	14.63	17.74	24.26	17.28	
REFINING	16.34	16.68	16.47	14.47	15.98	16.95	16.95	18.01	13.70	15.98	21.12	24.62	31.72	25.86	
GENERAL EXPENSES	15.23	18.32	15.46	12.74	14.91	14.99	15.29	17.81	14.36	15.60	25.60	18.02	30.75	23.80	
REPLACEMENTS	13.37	13.30	12.96	12.58	13.04	14.25	13.92	14.68	14.55	14.54	24.62	16.94	25.89	21.70	
TRANSPORTATION	17.16	17.43	17.35	15.73	16.90	17.07	17.25	17.65	23.55	18.61	22.59	25.26	34.10	26.20	
PORT HANDLING & FREIGHT	6.40	6.40	6.40	7.28	6.21	6.65	6.65	7.00	6.43	6.68	7.25	7.25	7.25	7.25	
ADMINISTRATION & SALES.	11.14	8.64	9.86	7.18	9.15	12.31	10.00	8.67	8.97	10.02	15.74	10.12	18.08	13.93	
TOTAL	178.40	180.84	184.64	175.87	179.47	185.64	186.17	195.25	204.62	192.14	228.08	222.58	281.96	238.95	227.4

STRIKE | PRODUCTION CEASED

R. S. T. Group

CHIBULUMA

	1964/1965.					1965/1966.					1966/1967					
QUARTER ENDED	SEPT. '64	DEC. '64	MAR. '65	JUN. '65	64/65	SEPT. '65	DEC. '65	MAR. '66	JUN. '66	65/66	SEPT. '66	DEC. '66	MAR. '67	66/67 (To date)	66/67.
FINISHED PRODUCTION LONG TON	5657	5678	5848	5735	22554	5880	4957	5713	6109	22661	4247	4064	4052	12363	17641
COST OF FINISHED PRODUCTION £s/LONG TON.															
MINING	61.85	66.04	63.40	72.04	65.75	61.45	57.94	67.79	70.68	64.77	66.87	127.65	74.29	89.28	
CONCENTRATING	13.78	13.33	13.20	14.60	13.72	12.53	12.53	14.93	15.65	13.98	15.27	18.36	18.21	17.25	
SMELTING + CASTING	11.00	11.00	11.00	11.00	11.00	12.03	12.14	12.20	12.07	12.11	14.66	19.43	29.66	21.18	
REFINING	—	—	—	—	—	12.15	12.14	12.47	12.92	12.53	12.10	7.13	10.03	10.10	
HANDLING + TRANSPORT	2.42	2.40	2.46	2.36	2.41	2.48	2.79	2.45	2.52	2.55	2.65	2.63	2.94	2.74	
MINE GENERAL EXPENSES	18.90	20.86	21.61	21.61	20.74	18.72	21.19	20.00	18.62	19.56	26.92	32.02	32.22	30.33	
REPLACEMENTS PROVISION	11.05	11.01	10.69	11.50	11.05	10.63	12.61	10.94	10.23	11.03	14.72	15.38	15.43	15.17	
TRANSPORTATION	17.81	17.81	17.81	15.85	17.33	17.53	17.39	17.93	22.57	18.67	23.72	27.23	27.53	24.10	
PORT HANDLING + FREIGHT	6.40	6.40	6.40	7.24	6.25	6.64	6.53	7.00	5.75	6.47	7.25	7.25	7.25	7.25	
ADMIN. + SALES.	7.40	7.61	11.02	10.39	8.97	11.22	11.68	10.71	8.01	10.33	14.95	13.17	16.14	14.80	
TOTAL.	150.61	156.46	157.59	166.59	157.22	165.40	166.94	176.42	179.02	172.00	199.11	270.25	233.70	232.20	217.4

· MAIN FACTORS AFFECTING COSTS IN THE LAST YEAR.

FLOOD

PRODUCTION CU

R. S. T. GROUP.

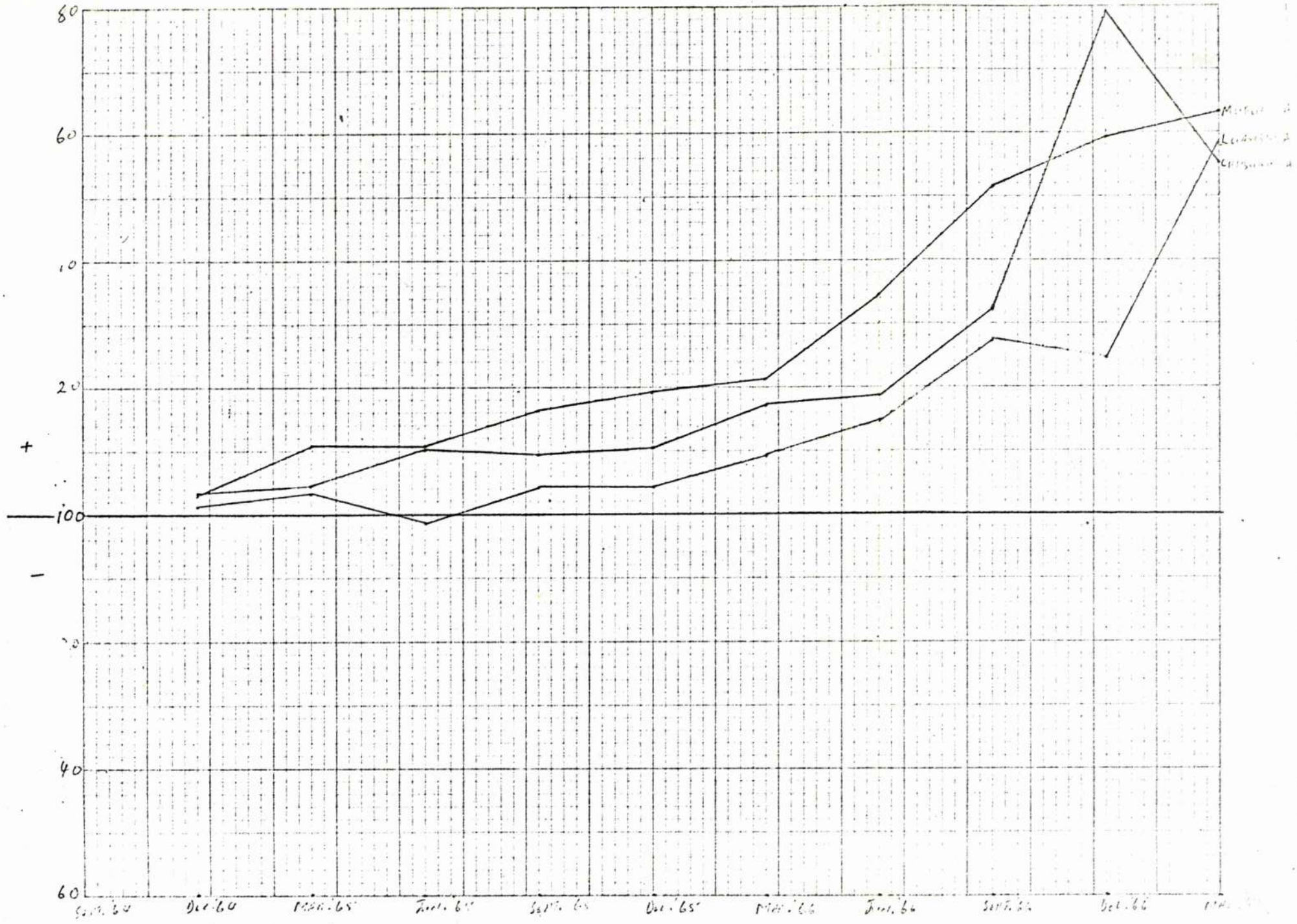
MUFULIRA.

	1964/1965					1965/1966					1966/1967				
QUARTER ENDED	SEPT. '64	DEC. '64	MAR. '65	JUN. '65	64/65	SEPT. '65	DEC. '65	MAR. '66	JUN. '66	65/66	SEPT. '66	DEC. '66	MAR. '67	66/67 (To date)	66/67
FINISHED PRODUCTION LONG TONS.	39678	41570	39514	40840	161602	38307	37692	41091	33410	150500	25303	30446	27655	83404	118392
COST OF FINISHED PRODUCTION £S/LONG TON															
MINING	44.59	46.16	51.99	57.17	49.98	54.67	56.10	61.51	67.51	59.75	66.09	72.37	68.66	69.23	
CONCENTRATING	10.74	11.41	12.20	12.29	11.66	11.84	11.69	12.48	12.98	12.23	13.17	14.12	13.60	13.66	
SMELTING & CASTING	7.78	7.97	8.30	9.62	8.42	9.94	8.83	9.96	12.55	10.25	12.88	15.96	17.21	15.44	
REFINING	7.74	8.35	8.55	8.29	8.23	7.85	8.44	7.54	9.75	8.31	9.66	11.29	12.95	11.23	
LINE GENERAL EXPENSES	1.45	11.75	12.70	10.21	11.52	12.84	13.66	14.73	10.25	12.98	21.83	19.52	19.32	20.15	
REPLACEMENTS PROVISION	6.93	6.61	6.96	6.73	7.43	9.14	9.29	8.52	10.48	9.30	15.81	13.14	14.46	14.39	
EXPORTATION	17.46	17.59	17.60	16.80	17.38	17.22	18.13	17.89	25.59	19.25	22.68	25.82	30.43	26.23	
ORT HANDLING & FREIGHT	6.40	6.40	6.40	7.32	6.21	6.65	6.68	7.00	7.25	6.89	7.25	7.25	7.25	7.25	
ADMIN. & SALES	8.47	9.21	9.73	6.29	8.62	11.18	12.60	8.24	7.13	9.83	15.30	13.95	14.67	14.60	
TOTAL	121.56	125.45	134.43	134.72	129.45	141.33	145.42	147.87	163.49	148.79	184.67	193.42	198.55	192.18	184.3

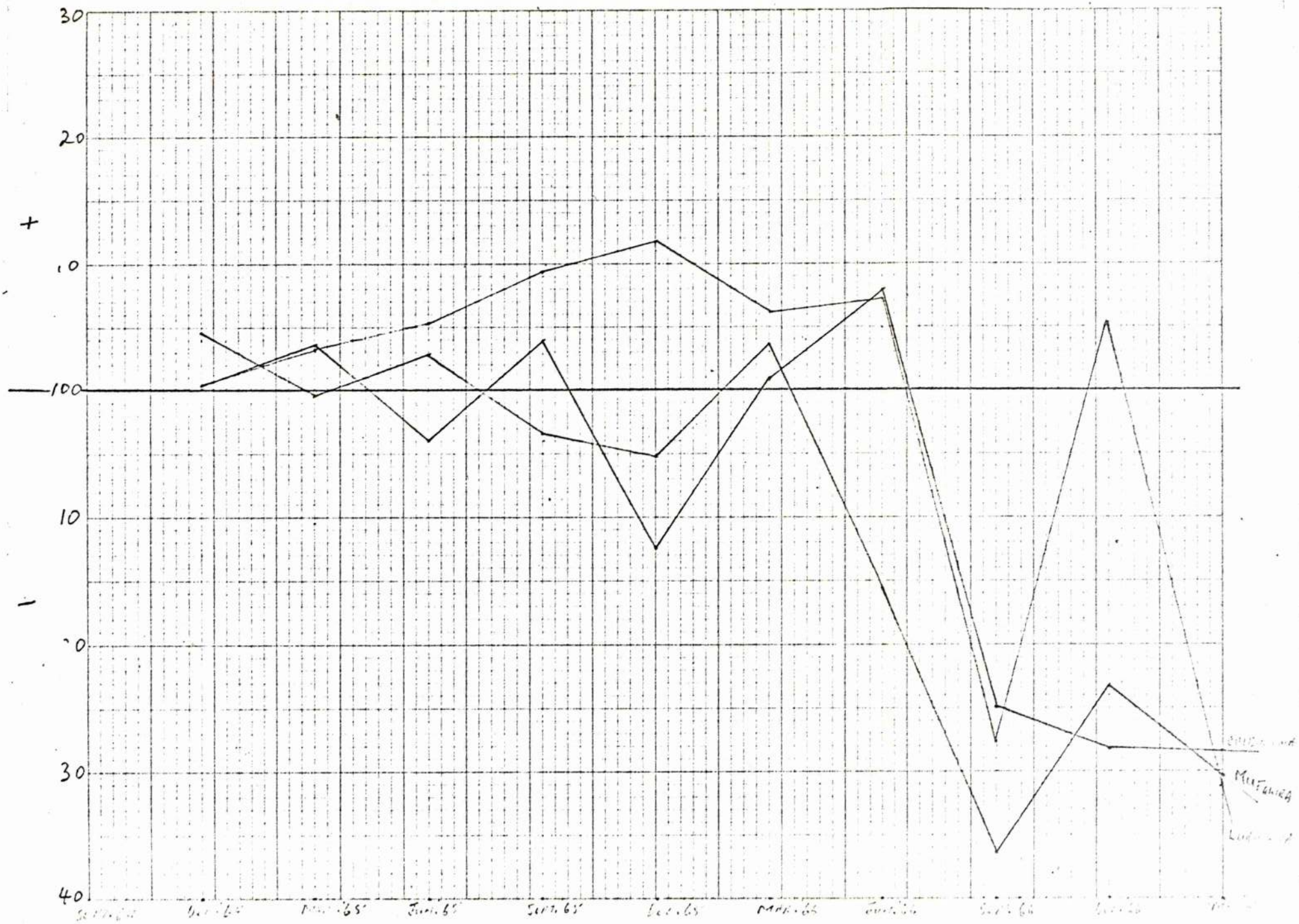
MAIN FACTORS AFFECTING COSTS IN THE LAST YEAR

STRIKE	PRODUCTION CUTS

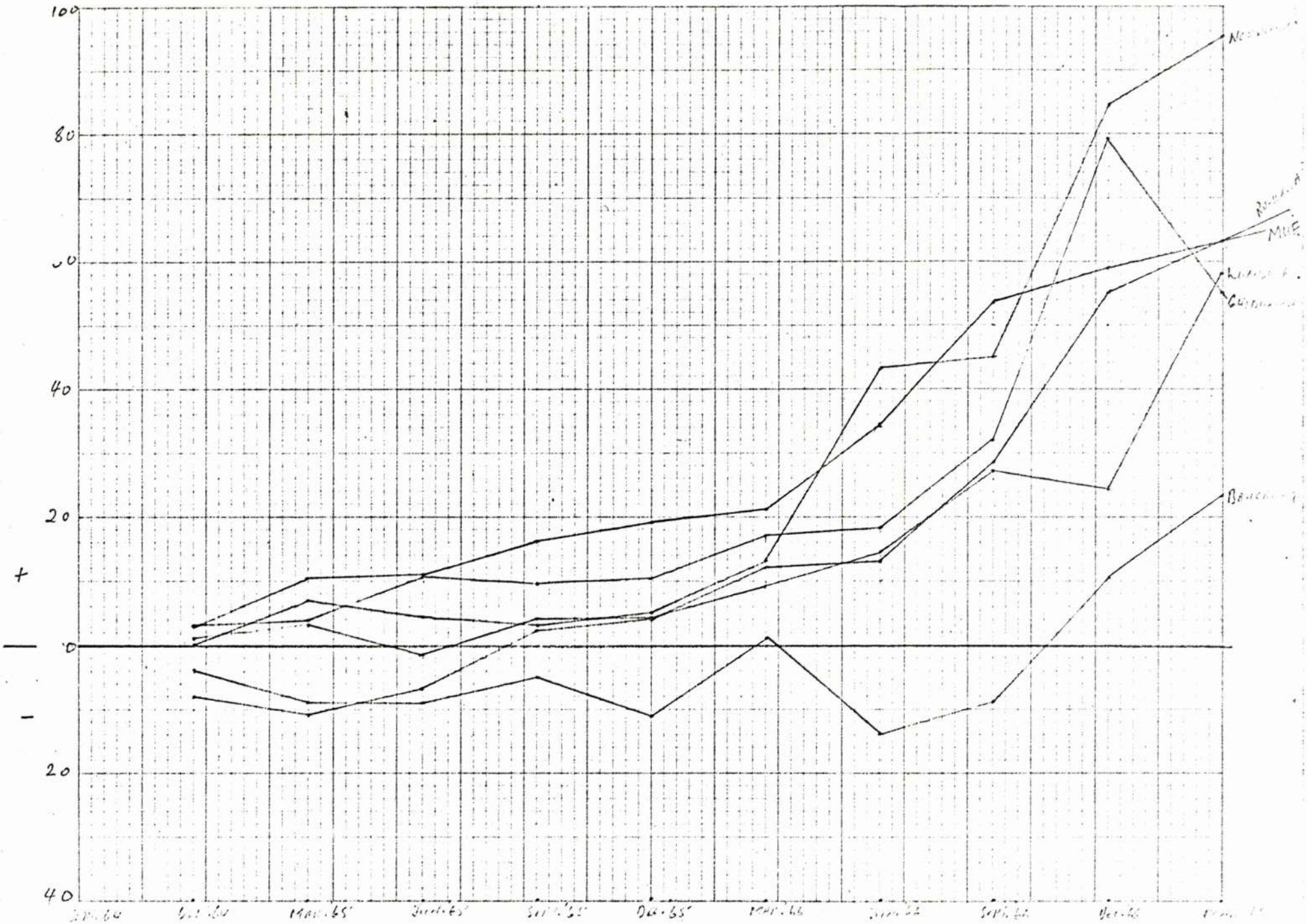
COPPER COST TREND % R.S.T. MINES.



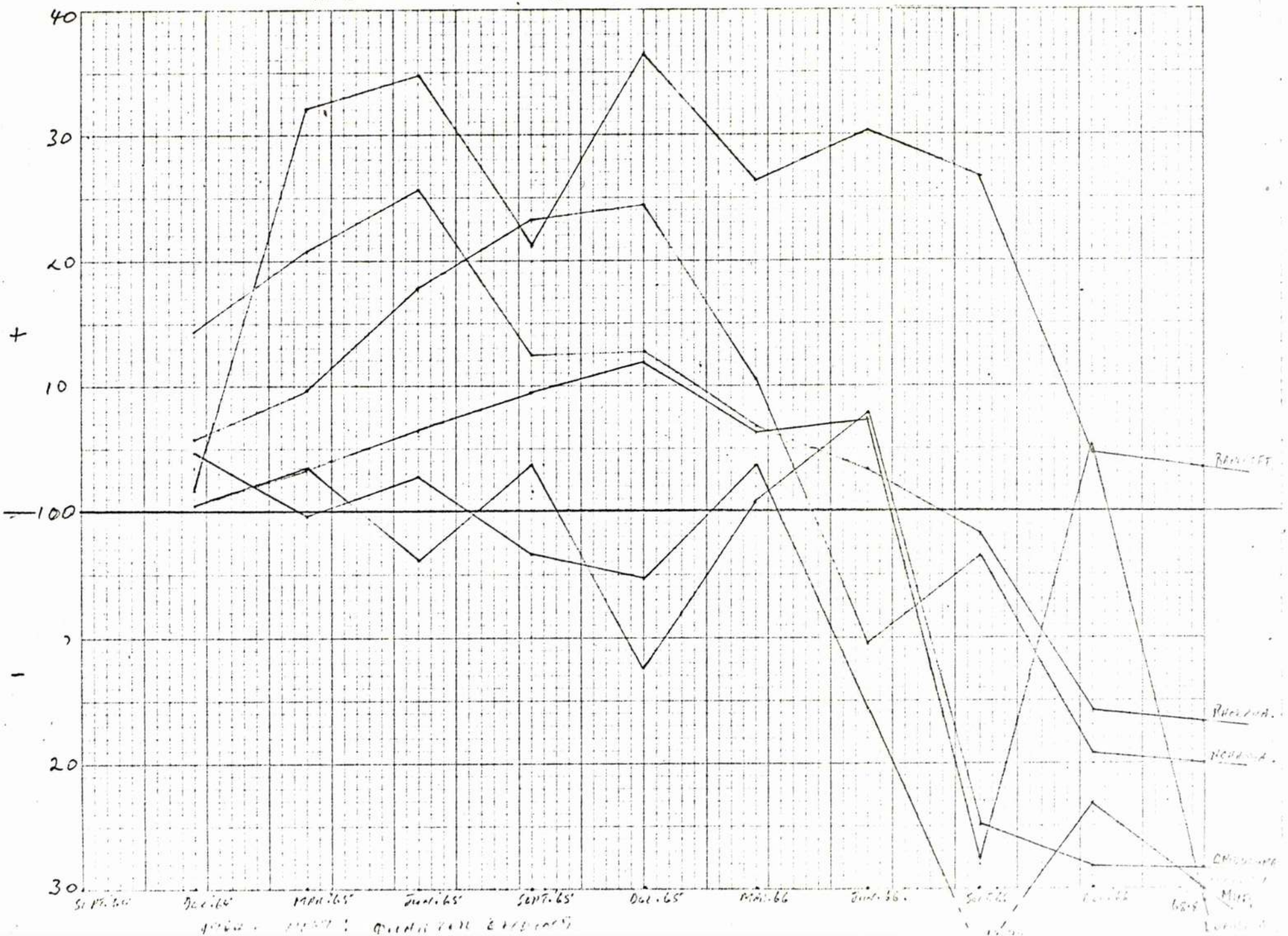
COPPER PRODUCTION TREND % R.S.T. MINES.



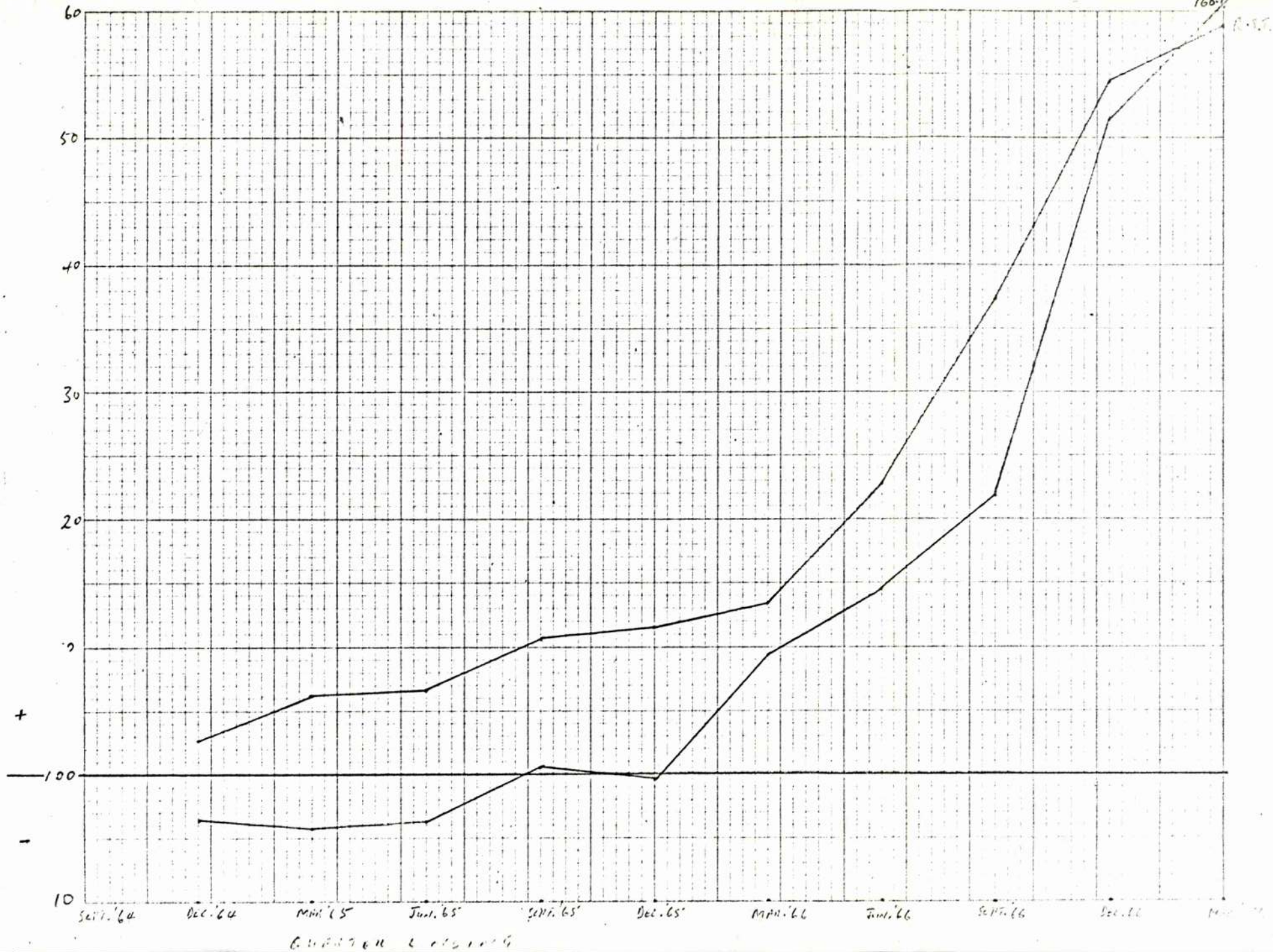
COPPER COST TREND % MAJOR COPPERBELT MINES.



COPPER PRODUCTION TREND % ALL MAIN COPPERBELT MINES.

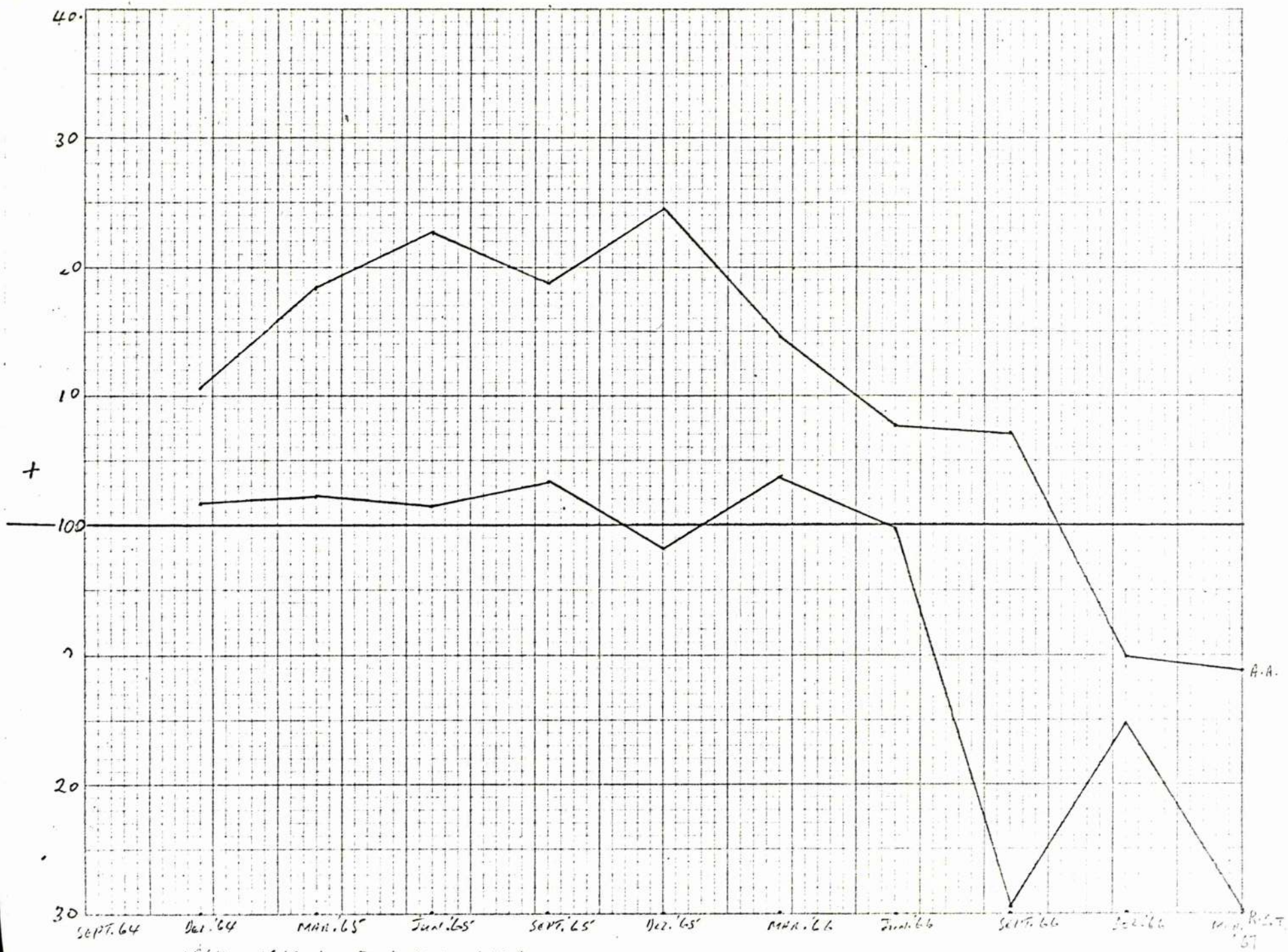


COPPER COST TREND % AVERAGE R.S.T. & A.A. MINES.



COPPER PRODUCTION TREND % AVERAGE R.S.T. + A.A. MINES.

68.14



A.A. that unit costs would be higher as the fixed costs would now be spread over a smaller level of output. On the other hand, a rise in output meant for the R.S.T. group a comparative fall in unit costs as fixed costs would then be spread over a larger quantity of output. The situation for A.A. was aggravated by the fact that even costs which would normally be regarded as variable were not sufficiently allowed to fall with the decline in the recovery of copper output. Government policy is that labour lay-offs should be minimised as much as possible. This means that even unskilled labour wages must form a considerable portion of fixed costs. For an enterprise that employs so much of semi- and unskilled labour, it is hardly necessary to emphasise the effect this must have on unit costs at a time when output declines.

Several factors explain why the average recovery of copper output for the A.A. mines fell so remarkably. The common factor which affected both the mining groups was shortage of fuel and the expense in obtaining the available quantities. The special adverse factors for A.A. were the drop in the grade of ore, especially at Nchanga mine where it was reported that the grade fell from 5.4% to 4.3% over the period. A drop in grade raises cost since it then becomes necessary to excavate a greater quantity of ore for a ton of metal to be recovered. It also raises costs since more overburden will now have to be stripped at the various processing stages. Indeed, because Nchanga produces almost 40% of all Zambian copper, its drop in grade affects the average of the whole Copperbelt whose grade is estimated to have dropped from 2.93% in 1964 to 2.5% in 1966.

The inherently high cost Bancroft mine has also tended to inflate the average cost of the mines of the A.A. During 1964/65 period production from Bancroft made out 8% of the total tonnage of finished copper compared to 65% from the low cost producer Nchanga. During 1967 the figures were 11% and 62% respectively. Obviously, in the absence of technological advances

when a high cost mine increases its output costs rise correspondingly or even at a higher rate.

Furthermore, both company groups have embarked on rather considerable expansion programmes during the period, and the (unofficial) estimated combined production for 1973 is 780,000 long tons against a production level of 607,627 long tons in 1967. It is hoped that when the expected output begins to get to the consumer market, a favourable labour-output ratio will result i.e. costs of labour per unit of output produced will fall. This of course depends on whether the new mines or the expansion programmes will entail the expenditure of more or less capital i.e. whether it will be more or less costly to bring extra output to the market. It could be that the expansion programme will entail a higher labour cost per unit of output and this could mean not a decline, but a rise in the overall labour cost per unit of production. One thing certain, however, is that until the expected output capacity comes into full production, not only labour costs, but costs in general, and therefore the unit cost, must continue to rise.

Apart from the general cost factors (which we enumerate below) the R.S.T. group of mines has not suffered from any special factors in comparison to A.A. group. This is evidenced particularly by the 7% increase in the production of recoverable copper over the comparable period.

A number of factors have contrived, so to speak, to raise costs for both the A.A. and the R.S.T. mines during this period. Some critical ones are the following: first are the labour costs. The Copperbelt operations, as implied above, are highly labour intensive. This factor has become more pronounced in recent times when the fall in ore grade has necessitated a greater intake of manpower required to produce the greater volume of ore per ton of metal to be recovered (holding technology constant). In consequence output per man has had to fall. (Chile is believed to employ only 1/3 as

much labour for roughly the same output, but in more concentrated operations). Besides, the policy of Zambianisation - including the costly training programmes which have been introduced - has also been felt in increased labour costs.

The Brown Commission's recommendation of 22% increase in wages from October 1966 would produce an increase in cost of around £15/LT (with an annual pay roll of the order of £50m. and a normal average output of 650,000 long tons p.a.).

Labour now represents around £75 per long ton for the industry. For A.A. mines direct labour costs are estimated to have gone up 35%, against only 13% for R.S.T. mines. For the industry as a whole this implies that wages represent a major part of mining costs in Zambia. Consequently the overall cost becomes very sensitive to changes or increases in wages.

The international sanctions against Rhodesia's U.D.I. have proved to be an intolerable burden on the economy of Zambia in general, and this has been particularly reflected in, for instance, the higher transport, fuel and stores costs. It is estimated that transport cost of finished copper from the Copperbelt to African ports increased at approximately £10 extra per long ton. The transport costs of goods from abroad to the Copperbelt (machinery, spare parts, etc.) varied in accordance with day to day events (e.g. interruptions of the Benguela Railway by activities of mercenaries or terrorists). These are estimated to have increased between £5 to £10 extra per long ton.

The fuel shortage was hardly mitigated by the use of coal from the Zambian mines. The Nkandabwe coal, in particular, has lower calorific tenure but higher ash and silica content which produces erosion and abrasion in furnaces, pipes and pumps. Thus reverbatory furnaces, e.g. at Mufulira, have had to go out of production for a time, implying that unit costs would rise not only because of reconstruction costs but also because while the furnaces are non-operative, only a smaller tonnage (at a constant cost) could

be processed elsewhere in the country. Moreover, the purchase price of local coal has been made higher than that from Rhodesia. The Rhodesian coal in turn, though relatively cheaper at one stage, became more costly later as the price was raised. In any case it has always been costly for the mining companies to have to finance the big stocks of Wankie coal at Livingstone.

In general, transport, ocean freight and port handling (including airlift) have had the effect of raising costs by some 50% for A.A. Mines and around 30% for R.S.T. This percentage difference reflects mainly the fact that the two mining groups did not always use the same alternative routes in an attempt to by-pass the Rhodesian territory to the coast.

During this period the level of production fell. This would be expected in a situation where costs were consistently rising at a faster rate than producer prices. Cutting back production would be an attempt to mitigate the rise in unit costs. But in fact, however, the fall in production was as much a result of deliberate cut back policy as it was a result of work stoppage or labour strikes. In some cases it was the result of natural causes like flooding. In consequence the 1966/67 output was estimated to be about 20/25% lower than normal. This means that fixed costs (e.g. management, overheads, financial charges and most of the labour costs) which are not proportionate to the numbers of units produced have to be allocated to a lower production, thus resulting in a higher cost per unit of output.

The effects of lower production require detailed analysis for each mine, e.g. the proportion of costs attributable to labour varies from mine to mine. However, it is estimated that fixed costs could be around 45-50% of direct costs. Management and professional labour (excluding production bonuses) is the main factor in fixed costs just as a large portion of ordinary labour is. In the case of "ordinary" labour, this fixity stems from the fact that neither Government nor the mines themselves, as a matter of policy, will

allow the producing companies to decrease the labour force in times of low production. This means that only a very small portion of labour cost will be variable. Such costs may include bonuses and a number of other fringe benefits normally received when the times are good. Labour lay-offs will be negligible. In consequence it is believed that the whole item of "lower production" could have led in 1966/67 to an increase of £25 - £30 per long ton.

Technical factors, as we have said, have also played an important part in raising costs. Thus, not only was the ore grade decreasing between 1964 and 1967 but also the ore had to be excavated from more deepened mines. This tends to raise not only the recovery costs but also the haulage and hoisting costs.

In addition, this has been a period of world wide inflation. The tendency has been to shift rising factor costs to consumer prices. This has meant that goods purchased abroad, and to some extent locally, have required a greater outlay than would be made under normal circumstances. In fact the cost of stores in general are estimated to have gone up 20% for A.A. as against 46% for R.S.T. The higher percentage increase for R.S.T. mines is largely due to the greater use of inputs for the Group's reverberatory furnaces. Such inputs will be fuel in general, but coal in particular.

This tendency towards increasing costs in the world is also the result of the closure of the Suez Canal which consequently led to higher cost of freight and "sales realisation". In this case it has been necessary to finance a big pipeline for fuel, with the expected favourable effects on sales realisation.

Different mines will have cost problems peculiar to them. We have here presented a general trend of direct costs in broad outline and believe it sufficient for our purpose.

(b) Indirect Cost

As we have already said, the major elements in this category of

costs are royalties and export tax. The analysis of the causal factors of these elements is crucial for our project as the elements are important determinants of total production and sales costs.

Again, we do not propose to labour ourselves with a rigmarole of description and analysis of this aspect of costs. Instead we refer ourselves to the attached tables to note how these elements have affected the industry over the period observed. The accompanying graph, the figures for which are calculated from the tables on production and sales costs, to which reference has already been made, bring into clearer relief the relationship between direct and indirect cost. We are at this point particularly interested in how royalty and export duty have moved and influenced the total production and sales cost over the period in question.

Only a brief comment on these tables will suffice for our purpose. The base period is given as 1965/66 and the terminal period is 1966/67. As we will recall, up to April 25 1966, copper was sold based on the producers' price but the royalties were calculated in accordance with the formula based on the LME quotation. Therefore, in spite of lower sales proceeds in 1965/66 (£270-£300/LT.), than in 1966/67 (£380-£400/LT.), the royalties were higher. (The exception here is Bancroft Mine which received an abatement from the Government in 1965/66).

From April 25, 1966, a new tax, the Export Tax was applied. This affects considerably the total sales cost during the period 1966/67, as can be seen when contrasted with the total costs in the preceding period 1965/66. This tax has since remained a major constituent part of the indirect cost incurred by the mining companies of Zambia.

Royalties are charged per unit of production, and because sales are sometimes affected by restrictions on railings, the unitary charge of royalty per long ton sold has been high in relative terms.

TABLE II

TOTAL COST OF PRODUCTION AND SALES

A. A. GROUP

PERIOD	1965/66 (ends June 30th)	1966/67 (ends 30th June)
	Zambia Anglo-American Group	
RHOKANA		
Production	96587 LT.	81929 LT.
Sales	97325 "	75982 "
Sales Proceeds	£289.0/LT.	£393.7/LT.
Cost of Sales excluding depreciation	£243.8/LT.	£349.1/LT.
Direct Cost	£185.1/LT.	£253.0/LT.
Indirect Cost (i) Royalties	£ 58.7/LT.	£ 52.5/LT.
(ii) Export Tax	-	£ 43.6/LT.
NCHANGA	(ends 31st March)	(ends 31st March)
Production	257650 LT.	187132 LT.
Sales	256187 "	195374 "
Sales Proceeds	£273.2/LT.	£380.9/LT.
Cost of Sales excluding depreciation	£180.9/LT.	£280.4/LT.
Direct Cost (X)	£127.1/LT.	£176.1/LT.
Indirect Cost: (i) Royalties	£ 58.8/LT.	£ 57.1/LT.
(ii) Export Tax	-	£ 47.2/LT.
BANCROFT	(ends 31st March)	(ends 31st March)
Production	36540 LT.	32809 LT.
Sales	35856 LT.	33116 LT.
Sales Proceeds	£273.0/LT.	£381.3/LT.
Cost of Sales excluding depreciation	£319.6/LT.	£385.9/LT.
Direct Cost (X)	£282.8/LT.	£281.6/LT.
Indirect Cost (i) Royalties	£ 36.8/LT.	£ 56.8/LT.
(ii) Export Tax	-	£ 47.5/LT.
Cost less revenue from ore processed for Nchanga	£244.6/LT.	£245.4/LT.

The average direct cost of A.A. Group at 31st March 1967 (the Balance of Rhokana is at 30th June) was £200 per long ton.

(X) Direct Cost include provisions for non-expansion capital expenditure.

TABLE II.1

TOTAL COST OF PRODUCTION AND SALES

R.S.T. GROUP

PERIOD	1965/66 (ends 30th June)	1966/67 (ends 30th June)
	Roan Selection Trust Group	
MUFULIRA		
Production	150500 LT.	118392 LT.
Sales	153984 LT.	120124 "
Sales Proceeds	£303.2/LT.	£411.0/LT.
Cost of Sales	£228.63/LT.	£285.04/LT.
Direct Cost	+£148.79/LT.	+£192.64/LT.
Indirect Cost (i) Royalty	£ 62.23/LT.	£ 48.36/LT.
(ii) Export Tax	£ 16.61/LT. (X)	£ 44.04/LT.
LUANSHYA DIVISION		
Production	97600 LT.	76940 LT.
Sales	97476 "	81136 LT.
Sales Proceeds	£306.4/LT.	£411.6/LT.
Cost of Sales	£273.46/LT.	£336.73/LT.
Direct Cost	+£192.14/LT.	+£241.09/LT.
Indirect Cost (i) Royalty	£ 69.97/LT.	£ 49.17/LT.
(ii) Export Tax	£ 18.35/LT. (X)	£ 46.47/LT.
CHIBULUMA		
Production	22659 LT.	17641 LT.
Sales	22963 "	18446 "
Sales Proceeds	£298.3/LT.	£411.0/LT.
Cost of Sales	£250.96/LT.	£324.06/LT.
Direct Cost	+£172.00/LT.	+£230.57/LT.
Indirect Cost (i) Royalty	£ 63.49/LT.	£ 48.17/LT.
(ii) Export Tax	£ 15.47/LT. (X)	£ 45.32/LT.

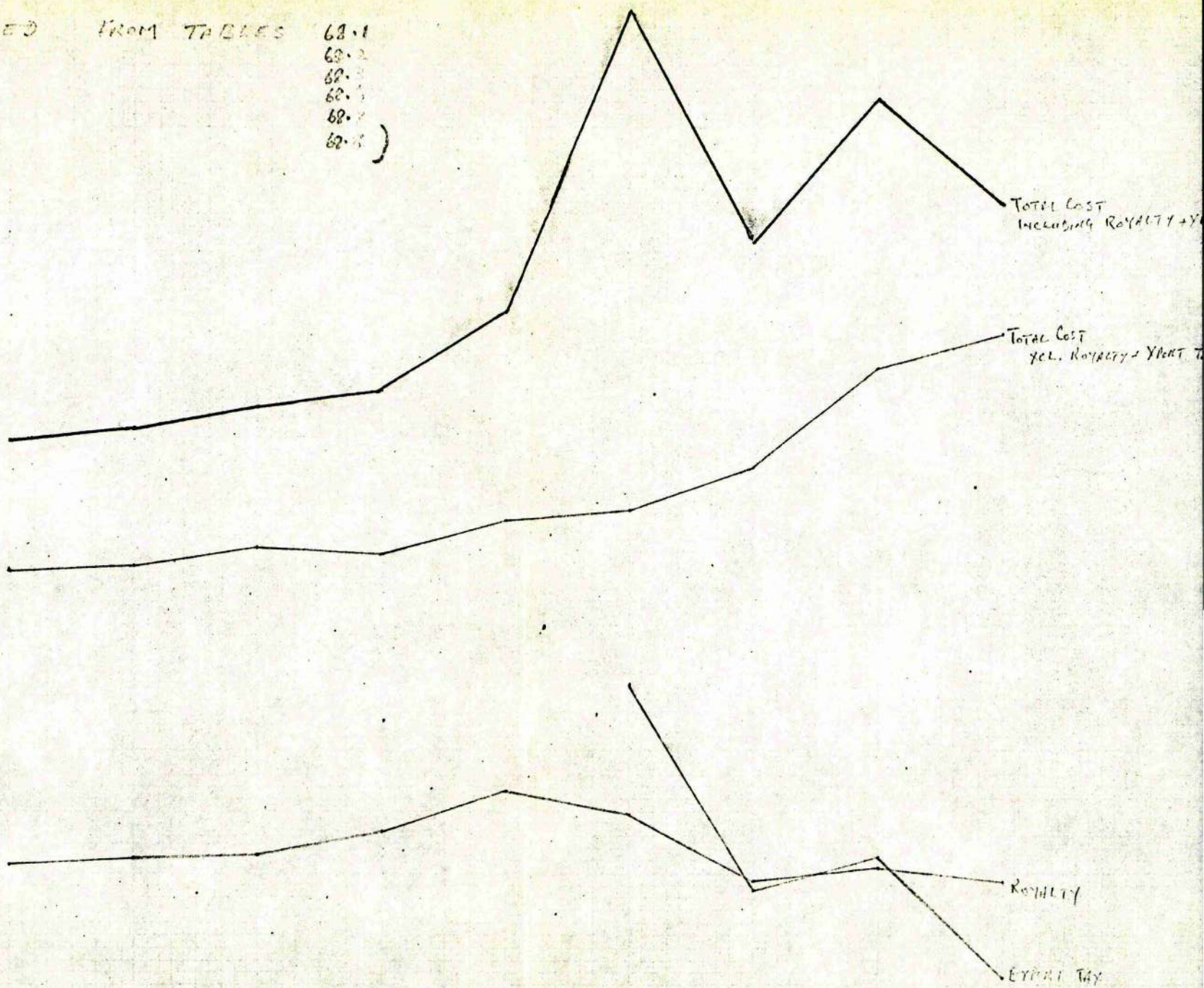
TABLE II.2

PERIOD		1965/66 (ends 30th June)	1966/67 (ends 30th June)
CHAMBISHI			
Production		10059 LT.	13807 LT.
Sales		8229 LT.	12579 LT.
Sales Proceeds		£315.7/LT.	£404.6/LT.
Cost of Sales		£368.89/LT.	£352.57/LT.
Direct Cost		+£275.03/LT.	+£259.99/LT.
Indirect Cost:	(i) Royalty	£ 69.30	£ 48.17
	(ii) Export Tax	£ 24.56 (X)	£ 44.41

(X) The Export Tax came into force on April 25, 1966.

The Average Direct Cost for R.S.T. Group	£140/LT.	£215/LT.

(DERIVED FROM TABLES 68.1 68.2 68.3 68.4 68.5 68.6 68.7)



Now observe the effect of all these factors on the comparative cost position of the Zambian copper mining companies in the world copper industry.

SECTION 4: COST COMPARISON - ZAMBIA COPPER MINES vs. OTHER COPPER MINES OF THE WORLD.

(a) Mining Costs[10] - Underground vs. Open-Cast Operations.

In the category of the large open-pit copper mines of the world cited here, Nchanga mine has a seemingly very unfavourable stripping ratio of at present 15.5. The cost per ton of ore mined over the period 1967 in Nchanga is about £1.65 (≠4.62). Dividing this figure by the stripping ratio (i.e. 15.5 + 1 = 16.5) we obtain a cost of ≠0.28 ($=\not\frac{4.62}{16.5}$) per ton of material moved. This figure falls between the range of ≠0.20 and ≠0.30. Which means that Nchanga's operational costs are comparable to costs of similar operations elsewhere in the world. In fact, if the relatively high costs of transportation of equipment and fuel were allowed for, Nchanga's position might even be much more comparable, i.e. more efficient than comparable operations in say, the U.S. and South America.

In general, the operational costs of such large open-cast operations will not vary much. It is said that the most significant variations in cost are in the categories of haulage and general mine cost. Haulage costs vary according to mine elevation, pit profile, crusher location and accessibility of a dump area; but general cost variations depend largely on the overhead cost items included in the category.

Mining costs for smaller open-pit operations are generally known to be much higher, firstly because equipment (shovels and trucks) will as a rule be smaller, thus raising the operating costs per unit higher; and secondly, because production will generally be low, general expenses will in many cases be higher per unit produced. It is instructive in this respect

to note that the Chambeshi mine (R.S.T.) has a cost of around $0.50 or 3/6 per ton of material moved. Apart from the smallness of its operations, another cause for the high cost is that only a relatively small quantity of the overburden is soft so that drilling and blasting costs at this mine are relatively high.

Generally speaking the large copper open-pit mines are said to show a much lower mining cost than underground mines. It is estimated that an average large open-pit copper mine in South America or the U.S.A. would produce one ton of ore at $0.75 (=5/4). And the total average mining costs in the Americas for both open-pit and underground mines are said to be around $0.84 (6/- = £0.3). In contrast the average cost of mining of Zambia mines during the period 1966/67 were considerably higher, as can be seen below.

The type of ore mined has special significance to comparative cost analysis. Depending on whether one type of ore is, say, sulphide, oxide, refractory, or mixed, treatment costs will vary accordingly. Normally, treatment costs of straight sulphide ores are much cheaper than those of the other type. For instance, although the Peruvian Taquapala mine has a low ore grade (around 1%, containing also a significant quantity of molybdenite), the costs are relatively low because the ore body is a straight sulphide ore. On the other hand, although they have a much higher grade, Nchanga and Chambeshi mines have mixed ores which result in higher treatment costs and lower metal recovery.

On aggregate, while the average cost of mining one short ton of ore in the Americas is around 6/- (=£0.3), the cost for the major mines of Zambia varies between £1.25 (Mufulira) and £2.58 (Bancroft) as follows:

TABLE 12

AVERAGE COST OF MINING, 1966/67

Mine	Production/Ore/Ton 30/6/67	£/LT Metal	£/ST Ore	Type	Ore Grade
Roan Antelope	6,040,000 ST	90	1.40	UG	1.85%
Mufulira	7,190,000 "	70	1.25	UG	2.50%
Chibuluma	650,000 "	90	2.64	UG	4.19%
Chambeshi	820,000 "	105*	1.70	OP	2.55%
Rhokana	5,333,000 "	100	1.60	UG	2.01%
Nchanga	5,345,000 "	60	1.88	OP-UG	4.25%
Bancroft	1,619,000 "	130	2.58	UG	3.48%

*Cost of the first 7 months of 1967/68.

The cost of £1.88 at Nchanga mine is of particular interest in our discussion. We will recall that the cost for the Nchanga open-pit (as opposed to the underground) mine has been cited as around £1.65 per ton of ore produced, and is comparatively so high because of the exceptionally high stripping ratios. It means that in fact the underground operations alone are responsible for a cost of around £2.11 per ton of ore produced for the mine as a whole (i.e. underground plus open-pit operations). The modifying effect of low-cost open-pit operations on the overall cost of Nchanga mine is self-evident, and makes the mine the comparatively low-cost mine that it is now known to be.

At £1.70 the mining costs at Chambeshi mine must be regarded as remarkable for the simple reason that in general open-pit mines are low cost mines. It is, of course, possible to explain this fact. As already mentioned above, this is due partly to the fact that being a relatively small mine, its unit costs will necessarily be higher. Besides, a relatively large part of the overburden is hard rock, thus adding to the difficulty and cost of stripping, and hence to the high stripping ratio.

Indeed, Chambeshi is not the only exception to the rule. Thus, the Chuquicamata mine, said to be the biggest copper open-pit mine in the world, has a higher cost of production than El Teniente, the biggest "underground" mine in the world. It must be added quickly however, that El Teniente is a special case of an underground mine. Locationally, it is situated in a hill so that the ore has not to be hoisted up and water problems, common to all real underground mines are not existent here and there are practically no pumping costs.

(b) International Competitiveness: Zambia vs. Other World Producers

Mention has already been made of the fact that the Lusaka Copper Conference produced a table showing the 1967 structure of costs of leading producers of competitive copper in the world. We reproduce that table here for ease of reference, in the ensuing analytical discussion.

TABLE 13

ESTIMATED AVERAGE COST OF "COMPETITIVE" COPPER IN LEADING COUNTRIES, 1967

Country	Total Capacity ('000 tons)	Competitive As Proportion to Total Capacity %	Net Cost LT.	Break-Even Cost LT.
Peru	354	64	170	129
Chile	793	94	173	152
South Africa	143	100	172	158
U.S.A.	1622	97	189	172
Australia	140	94	194	176
Phillipines	95	94	195	179
Canada	599	58*	232	185
Zambia	781	100	279	217
Congo (K)	330	100	294	244
Elsewhere	635	24	250	230
Non-Soviet World total	5372	81	214	183

* 58% of Canada's production is by/co-product at nominal cost.

Source: Lusaka Copper Conference, Technical Papers, 1967.

These estimated costs were standardised by taking all production to the electrolytic stage, delivered to customers. The term "net cost" in the table is defined to include all charges except taxes on profits. So that terms such as royalties, export taxes and duties, customs duties, interest on borrowed money, depreciation and replacements expenditure are included. And the price at which cost is computed "net" is taken to be £350 per long ton. The "break-even" cost refers to the point at which cost equals price and the term excludes any provision for depreciation of the original capital investment.

In the footnote of this table its authors make a special comment on the Canadian output capacity. A 38% competitive output capacity is believed to be deceptive because 58% of Canada's production is a by-product at nominal cost.

It is also apparent from the table that the tropical African producers are in the highest cost bracket of the major producing territories. But although the U.S. Producer costs may appear comparatively low, they can be expected to go up as a result of the new three year wage contracts subsequent to the ending of the copper strike.

In contrast, Chile producers can expect a relative decline in net costs in the foreseeable future. It is believed that the figure of £173 was probably on the high side of estimation. Admittedly, the recent wage increase of 35% is impressive but this has to be seen against the long-term output expansion programmes.(11) Thus it is expected that El Teniente will increase output capacity from 162,000 long tons to 252,000 long tons; Chuquicamata from 290,000 to 460,000 long tons, in conjunction with the Exotica mine. This output would greatly lower costs in the future. Moreover, every 15 months the Unions and Companies revise the labour contracts, and usually the wage increases reflect mainly the cost of inflation plus of course a small real increase.

Possible wage increases in Peru could probably also be largely or totally offset by production increases. Moreover, most Peruvian mines enjoy conditions of low cost production. For instance at Toquepala the low cost conditions are most favourable: i.e. the ores are all of the sulphide type and therefore extraction costs are low, and the distance from the mine to the seaport is only 116 miles; loading in the mine is largely directly in railroad cars; and the stripping ratios are low.

Zambia mines are not placed in a similarly advantageous position. The American producer "Bagdad Copper Corporation"[12] is said to have had a production cost of 18.4 cents per pound in 1967. This would be equivalent to £147 per long ton. None of the mines in Zambia can produce at as low a cost as that. During the same calendar year the average costs per ton for the various Zambia mines were as follows:-

TABLE 14

AVERAGE PRODUCTION COST PER TON DELIVERED, ZAMBIA MINES, 1967 (£/LT)

Mufulira	182.8
Chibuluma	214.3
Chambeshi	252.0
Luanshya Div.	241.3
Nchanga	204.4
Rhokana	241.9
Bancroft	283.5

As noted earlier (page 49) the average cost for the industry was around £215/LT (= 27¢ per lb.). At this level of costs of production, the Zambian industry would be placed in the low cost bracket comprising 60% of free world producers. But in order to arrive at the comparable "net cost", royalties and the export tax have to be added to give a total of around £275/LT (for a break-even price of £350/LT). (Note: Table 12 shows Zambia's

"net cost" to be £279/LT in 1967). At this level of costs Zambia mines are placed in the bracket comprising 30% of producers with high costs.(13)

Having made these observations, we may, in the particular case of Zambia mines, briefly indicate the implications of such levels of costs on the yield of investment. The brief appraisal is important because it indicates the extent to which the industry in Zambia can look outside for foreign capital inflow. This, as we know, is always one of the major sources of investment capital particularly in the mining industry of this country. For instance, Rio Tinto-Zinc has 11% interest in the Rhokana mine. Anglo-American Corporation holds nearly 30% interest in Zambia's main holding company Z.A.A., and, as we may also remember, we noted that the giant American Metal Climax has 46% interest in Zambia's R.S.T. mining group as a whole.(14) There are also significant minority shareholders resident abroad.

Again the appraisal is essentially indicative rather than decisive. This is because of the unsatisfactory data available for the analysis.

(c) Investment Efficiency or Yield of Zambia Mines.

The break-even copper price for the Zambian mines as forecast by the Government in the current national development plan is £350/LT. We have seen that at this price the average net cost for the Zambian mining industry equals about £275/LT., i.e. a gross profit of £75/LT. which is reduced to a net profit of around £41.25 by a profit tax of about 45%.(15) Given a base or parameter, this net profit is easily expressed as a rate of yield of capital investment.

Some of the bases used for this purpose are the book value, the market value of the shares, new value of replacement of the installation, etc. A widely accepted system used in the mining industry in the U.S.A. is to refer the profit to the year's sales value - i.e. £41.25 to £350, or about 11.8%.

Another rough system will be to appraise the yield of new investment, given that the average investment in a new mine required to produce one long

ton of finished copper in bars, is around £500/LT. Suppose then that the expected net profit from the new investment is comparable i.e. £41.25; in this case our yield would be $\frac{41.25}{500}$ or 8.25%.

If the book value or the assets value were used, this net profit for the Zambian mines would yield a percentage rate of about 13.75%. (The asset value of the mining companies was approximately £200,000,000 according to the annual report 1966/67; that is, around £300/LT. for the normal level of production of 650,000 to 700,000 long tons per year).

Now, ordinarily, a rate of return in mining investment consists of a normal rate (i.e. return as interest on capital) plus a substantial additional amount that should accrue in proportion to the hazardous nature of mining business. This is why the rate of mining profit will be generally high relative to profits on say, most replenishable investment assets (See Chapter 6, esp. Sect. 2 of this study). It is thus observed that to be satisfied with less than 10% annually would show a lack of acumen, and a much higher rate would not be exorbitant for most mining ventures. Quite clearly, therefore, the investment returns (or the marginal efficiency of investment) of Zambia mines are, at say 8.25%, unsatisfactory from the international point of view.

Nor is the assumed rate of return on assets value attractive enough. Thus normally accepted yields for the mining industry in developing countries which involve the "mining risk" plus political and other risks are considered to vary between 15% and 20%[16] (and sometimes even more) on investment. This makes our figure of 13.75% compare very unfavourably both in terms of the industry's own previous performance and with respect to the normal rate of return in the international economy. All this reflects, of course, the recent increases in production and sales costs of the Zambian mines. No doubt had the costs moved according to the estimated trend in the development plan, profitability in the mining industry, at the assumed price of copper,

would have been attractive even by international standards. (The Plan assumes costs of £153/LT. for the period 1965/66, rising to between £171 to £182 in 1970.)

The industry is obviously less attractive, on our reckoning that had been expected by both the Government and the Mining companies of Zambia. There is comfort, however, in the knowledge that for the period observed, the cost factors responsible for this comparative unattractiveness of the Zambia industry were largely short-term. Thus, apart from the wage costs, the main cost increases were largely the result of the economic war between Zambia and Rhodesia. To this extent, we can say that the prospects of the Zambia industry are not as glowing as our calculations above might suggest. That is, in the long-run the prospects of the industry are determined by the geological nature of the copperbelt vis-a-vis the nature of the copper ore body of countries like Chile, Congo, Peru and the U.S.A. This is what will be decisive in establishing the comparative competitive position of Zambia mines in the international copper market.

The Copperbelt of Zambia contains some of the richest copper ores of the world. At an average copper content of around 3% to 4%, the quantity of the Zambian orebody is by far among the highest, compared to some of the American orebodies (e.g. in Peru and the U.S.A.) where in some cases copper content is only about one per cent). This would give the Zambian industry a long-term competitive advantage over the other world producers of copper. However, as we point out in section (a) above, this advantage will be modified by the fact that chemically the Zambian ores require a greater outlay for treatment per ton. This is why even although comparatively some Peruvian mines may be endowed with an orebody of low metallic content, because the chemical nature of the ore is easier to treat, the cost of mining is more favourable in Peru than it is in Zambia. This means that even in the long-

run the Zambian industry is less competitive than similar industries elsewhere in the world, ceteris paribus.

Hence, in order to make the overall cost-position of the Zambian industry more favourable and more competitive, cost factors of a non-geological nature would require to be appropriately adjusted or reduced wherever possible. Indeed, this is largely why, given the level of production costs (other than tax costs), the present-day debate on taxation of the mines is one about the presumed adverse effects of royalties and export duty on the competitiveness of the industry in the world economy. The popular argument against the royalty and the export duty is fairly familiar though basically illogical. For, as we point out in Chapter 2, if all items of cost including taxes influence each other one way or the other, and we know that the selling price itself normally represents a major part of the production costs, it is not possible to single out a particular item of cost as being responsible for the industry's comparative high costs (or high prices) without involving oneself in circular reasoning. This is not denying the fact that the two cost items of taxation observed form a significant part of total costs which account, together, for the industry's observed comparative cost position.

Our argument in this connection does not stem from the fact that the proportion of cost attributable to taxation i.e. royalty and export duty etc. is comparatively significant per se; but rather from observation of the possible incentive (or disincentive) effects on industrial production and investment activity of the mining sector, given Government policy on the development of the industry. Thus, in our tax proposals, we take the view that a system of taxation which does not discourage the expansion of production and that of productive capital is desirable, in the specific case of Zambia it is a primary requirement towards the fulfillment of the development objectives of the economy.

CHAPTER 3

REFERENCES AND FOOTNOTES

1. See T. J. Hoover in "The Economics of Mining (Non-Ferrous) - Valuation Organisation, Management". 3rd Edition, Stanford University Press, 1948, P 1ff.

   R.D. Parks in "Examination and Valuation of Mineral Property". 3rd Edition, 1949 Pp. 1-2.

2. See A. Neve in "Soviet Economy", Minerva Series No.6. George Allan & Unwin Pp. 218-226: 'Investment Criteria".

3. See Truscott in "Mine Economics" P. 177

   P. T. Flawn in "Mineral Resources - Geology, Engineering, Economics, Politics, Law". Rand McNally & Company P 11 (and footnote)

   R. D. Parks op.cit. P 114-116, 117-119.

   T. J. Hoover, op.cit. P 109ff.

4. See American Geological Survey and U.S. Bureau of Mines: "Investigation of Natural Resources" Subcommittee Hearings, U.S. Senate Committee on Public Lands, May 15-20, 1947 Pp. 119-120.

   T. J. Hoover op.cit. Chapter 1.

5. Primary crushing is done underground: the final crushing into powder is a surface job. So are the smelting and the refining prices. After smelting, slag is poured off during the process of removing impurities rom sulphide concentrates. Most of the 99.5% pure copper remaining goes through more refining by fire to become 99.85% pur cast anodes. The copper anodes are further refined by electrolysis. For about 3 weeks the anodes are immersed in electrolyte with their copper "cathode starting sheets". As electric current passes through, 99.97% pure copper is deposited on the sheets. The refined scrap is then stacked and sent for selling broad and on the LME.

6. See Mining Journal, Volume 270 No.6911 - a leading article entitled "Zambia's Achilles' Heel" in reference to the transportation problems after Rhodesia's UDI. Pp. 81-82.

7. See R. L. Prain (Sir). Op. cit. Pp. 89-90.

   Also refer to a Lecture given to OHDP Professional Staff by Mr. Kelly, Chairman of Z.A.A., on 11/3/68.

8. See Truscott op.cit. Pp. 183-186.

   T. J. Hoover op.cit. - On Recoverable Value and Cost of Mining - Chapter 7.

9. On Production and Sales Cost, etc. see Tables and Accompanying Graphs in this Chapter. Figures from Files MLM 4915/4 and MLM/6-11.

   Also see Seers Report (UN/ECA/FAO 1964) on Zambia, P. 42, and The "Guardian" of 19/6/67, an article "Sanctions Sacrifice Costs Zambia £30m."

   Mining Journal Volume 270 No. 6911 op.cit. Pp. 81-82.

10. As at ref. 9 above

11. See Mining Journal Volume 270 June 14/68 P 491 - Chilean Copper Production. Volume 271 July 5/68 P 13 - El Teniente (Wage) Agreement; July 26/68 P 67 - Chilean Copper Output.
Actual figures quoted in this text are from Lands and Mines Files MLM/4901/54 and MLM/4915/4.

12. See "World Mining" Journal of April 1968, and the MLM Files at (11) above.

13. "Notes on Future Mine Production and Present Cost Structure" by Sir R. L. Prain in International Wrought Copper Council Extract in MLM/4195/4.

    Also see Z.A.A. Annual Report by Chairman, 1965 and 1966.

14. See Financial Times, 8/5/69.

15. See Ref.8 of Chapter 2. Note particularly, that in the latter part of 1967 up to the beginning of 1968, copper prices were rising faster than costs. Thus profits were remarkably high for the Zambia mining companies. This further modifies our observations on investment yield of Zambia mines.

16. See T. J. Hoover, ibid. - On Valuation of Mining Properties and O.D.I. publications of 1965, et al.

CHAPTER 4

A CRITIQUE OF MINE TAXATION IN ZAMBIA

In the preceding chapter we indicated the relative significance of the various items of cost which together are responsible for making the Zambian mining companies less competitive in the world economy. That is, we attempted to demonstrate that Zambian mines are becoming less competitive in the international market when one compares production costs plus non-income tax liabilities. We also noted that at a rate of yield of 13.75% on capital, the Zambian industry was less profitable and consequently less attractive to prospective investment than had been expected or desirable.

In this chapter our task is to analyse the system of mine taxation in so far as it is relevant in determining the level of profitability and attractiveness of the mining industry.

The mining industry of Zambia, as we know, is subjected to three main types of taxation, e.g. the Royalty, the Profits tax, and, in the case of copper output, a tax on exports. We now propose to discuss these tax structures more fully and critically.

A. ROYALTY

Our treatment of the royalty problem at this point of our study is in three main stages. First we describe the current system, its derivation, etc. We then analyse its major implications in so far as it is a static formula. In the final pages we show that our main criticism does not follow simply from the observations made in the preceding pages, but rather that there is a fundamental fault inherent in this formula, principally from considerations of industrial productivity.

In Zambia the question of mineral rights and ownership is defined by Chapter 91 of the Laws of the country[1]. The minerals in the soil of Zambia are the property of the nation. Thus, in contrast to the concept of private ownership no person or persons can become rich overnight on dis-

covering mineral ores underneath their land. In fact the Act provides only that a person or company can obtain prospecting licenses and finally be permitted to work the mining location for profit after a certificate of special registration has been issued to him. He will be required to pay the stipulated annual royalties in addition to a profits tax, and, if he is mining copper, a duty on exports.

Specifically, the royalty payment is prescribed by Section 17 of the Chapter 91, 1965. At the prices of metals ruling at the present time, the various mineral royalties are paid as follows:

Copper - 13.5% of a certain average of spot and forward LME prices of several types of finished copper minus £8.

Lead - 10% of the LME price, minus £1.16.0d.

Zinc - 12% of the LME price, minus £2.10.0d.

Cobalt and Cobalt-bearing materials sold in forms other than alloy
- 5% of the gross amount per lb.

There are in fact a number of other minerals and metals on which royalty is paid by the mining companies. The mineral rights were transferred from the British South Africa Company (B.S.A.C.) to the Government of Zambia on the 24th of October, 1964. Since then the Mines Department has been empowered to assess and to collect royalties every month. The Department is also responsible for collecting all rents due to Government on Special Grants of the Mining Rights and Exclusive Prospecting Licenses, Inspection Payments, Registration fees, etc.

The four types of royalty quoted here should suffice to illustrate the meaning of royalty and how, in the case of copper, the formula is arrived at. It is clear from the formula, that for each different type of mineral the royalties are a uniform levy for all mines producing them.

The royalty payment itself is comparable to an ad valorem customs duty. The amount on each type of metal will invariably depend upon the

LME price for the given metal. In the case of copper, the LME price in the formula will be that of refined copper.

The copper royalty formula 13.5% P - £8 is arrived at as follows: the simple unweighted average of the LME spot and forward average price of electolytic wire bars, less 10% , is computed. This is the price P in the royalty formula.

Depending on the level of price P, the actual computation of royalty will vary as follows:

(1) If P is less than £55, the royalty (R) is R = 0.02P.

(2) If £60 P > £55, the royalty (=R)=0.0255P.

(3) If £80 > P > £60, the royalty is R=0.125P - £6

(4) If P> £80, the royalty is R=0.15P - £8

Now, the price of copper has been above £80 since 1946. Therefore only the last formula i.e. R=0.15P - £8 has application at present. This formula can be re-written if the unweighted average of the spot and forward prices during the months of production without the deduction of 10% is denoted by $\bar{P}$. So that the P in the royalty formula becomes $P=\bar{p}$ (.9), and the royalty formula then reads:

$$R = .15\bar{p}\ (.9) - £8$$

$$R = .135\bar{p} - £8$$

$$R = 13.5\bar{p} - £8$$

This formula has been in operation, unchanged, since its inception by the B.S.A.£. in April 1937. This explains the price ranges for which differential royalty percentages were fixed.

The reform of the royalty tax interests the mines greatly since it is regarded as the most onerous tax that the industry is made to bear. However, as pointed out earlier, this in itself would not be a valid argument for reform of the royalty tax. In the following paragraphs we indicate why the need to review and reform this formula is long overdue.

As just mentioned above, the derivation of the current copper royalty formula reflects the trend of the effective parameters during the time of its inception. Thus, from 1932 to 1939 the average annual LME prices fluctuated between £31.7 per long ton in 1932 and £54.7 in 1937. The Zambian Planning Office calculations also show that these LME figures fell to £40.7 in 1938 and £42.7 in 1939. It thus appears that at the time it was thought that a price of $P = \bar{p}(.9) = £55$, corresponding to $\bar{p} = £61.1$, was an exceedingly high one. For this price a royalty of 2% (i.e. 0.02P) was fixed. If P were to rise to £60, corresponding to $\bar{p} = £66.6$, the approximate royalty was deemed to be increased from 2% to 2.25% (0.0225). A further increase to $\bar{p} = £88.8$ may have been considered highly unlikely, but if it did occur an increase of the royalty from 2.25% to 12.5% P less £6 would be payable. The implicit assumption here is that costs would lag far behind prices per ton. Finally, a rise of P above £80, corresponding to a rise of $\bar{p}$ above £88.8 was perhaps thought to be hardly likely. Hence a royalty equal to 0.15P less £8 was merely a theoretical or hypothetical ceiling.

Thus it is apparent that the price range which seemed realistic in April 1937 lay between less than $P = £55$ and $P = £80$, corresponding to less than $\bar{p} = £61.1$ and $\bar{p} = £88.8$. The royalty between these limits varied from 2% to about 5%. The maximum possible would be $0.15P - £8$, corresponding to $0.135\ \bar{p} - £8$.

Now, over the years, the purchasing power of the British pound sterling (B£) on which this formula is based, like many other currencies in the world, has been dwindling. But the current royalty formula does not reflect this fact. The formula can, however, be updated by the use of an appropriate price index, although this may not be necessary from the point of view of fiscal requirements. On the other hand, it is true that the level of industrial or company profitability will depend, over the years, on whether or not cost factors like royalty are constantly

adjusted to the general trend of prices.

The annual wholesale price index in 1965 is given by the Ministry of Lands and Mines in Zambia as 4.165. This corresponds closely to the figure given by the "Statist" in the same year. Thus, applying this resulting multiplier of 4.165 to the price range of the royalty formula, the values of the re-appraised royalty formula are obtained, as shown in the attached table. Note that to bring the royalty for the price of e.g. P = £80 in 1937, or £333.2 in 1965 up to date the deduction of £6 would also have to be multiplied by 4.165 to take account of the depreciation of the pound. The formula would therefore read:

$$R = 0.125P - £25$$

$$\text{or } R = 0.1125\bar{p} - £25$$

Similarly, the formula for the price range above P = £80 in 1937 or £333.2 in 1965 would read (note that £8 in 1937 has the same purchasing power as £33.3 in 1965):

$$R = 0.15P - £33.3$$

$$\text{or } R = 0.135\bar{p} - £33.3$$

We can see that compared with 1937 the royalty in 1965 constituted a much bigger share out of the LME price on the basis of the operation of the current royalty formula. This results from two main reasons: (1) because the price $\bar{p}$ has risen from under £61.1 to over £88.8 at 1937 purchasing power of R£, or from under £254.4 to over £370.2 at the 1965 purchasing power of B£; (2) because the deductable items £6 and £8 per ton stayed the same instead of being raised to £25 and £38.3 respectively. In effect, therefore, these increases of royalty payments occurred while costs rose much more than prices. Correspondingly, the relative profitability of the industry or company is less than it otherwise would have been.

REVALUATION OF PRICE LIMITS

1965 PRICE INDEX 4.165 (SEE TEXT)

PRICE RANGE	AT PURCHASING POWER OF £1 IN 1937	AT PURCHASING POWER OF £1 IN 1965	CORRESPONDING ROYALTY FORMULA APRIL 1937.
UNDER	$P = £55$	$P = £229.1$	$R = 0.02P$
P £55	$\bar{P} = £61.1$	$\bar{P} = £254.5$	$R = 0.018\bar{P}$
FROM P=£55	$P = £60$	$P = £249.9$	$R = 0.0225P$
TO P=£60	$\bar{P} = £66.6$	$\bar{P} = £277.7$	$R = 0.02025\bar{P}$
FROM P=£60	$P = £80$	$P = £333.2$	$R = 0.125P - £6$ $= 0.05P$
TO P=£80	$\bar{P} = £88.8$	$\bar{P} = £370.2$	$R = 0.1125\bar{P} - £6$ $= 0.045P$
	$P = £6$	$P = £25$	
	$P = £8$	$P = £33.3$	

Another aspect of the formula is that in its operation as an ad valorem duty, it has economic implications which may not be desirable from the point of view of industrial productivity in general. These implications may be illustrated by the following brief account:

(a) As a general statement the costs of raw materials, i.e. royalties are an increasing part of a rising price. In the example below it can be seen that the rate of cost increase is comparatively much faster than that of price at a price of P = £80 or $\bar{p}$ = £88.8. In fact the rate increases rapidly below this price, and in the range above it the rate of increase becomes less because the deduction of £8 becomes a smaller and smaller proportion of a rising price, viz.

At $\bar{p}$ = 88.8	£8 is 9%
$\bar{p}$ = £300	£8 is 2.6%
$\bar{p}$ = £400	£8 is 2%
p = £500	£8 is 1.6%

Conversely, this means that as the price decreases the decrease of the royalty is more than in proportion to the price decreases (some exponents may observe a case for lower prices which have also the effect of dampening the desire for copper substitution by overseas customers).

(b) As long as prices rise faster than costs in general, the relative increase in royalties charged in this formula, is offset by the relative decrease in all other costs, e.g. transformation costs (i.e. extraction, concentration, smelting, refining and casting costs), marketing costs, transport and insurance costs and administrative costs. Conversely, if prices fall more rapidly than costs, the relative decrease in royalties is offset by the extent to which these other costs increase. That is, the profitability of the industry depends on the overall relative changes in prices and costs.

(c) The Zambian royalty tax is levied as a proportion of unit value

of production. In effect it means that where sales are less than production, the tax raises problems of liquidity, and this could create serious short-term problems for the industry (see Chapter 3, Section 3), which is required to pay the tax in cash and not in terms of stocks or inventories.

In this connection our primary interest is not so much the relationship between royalty and the cost-price situation of the industry as a whole. We are concerned primarily with the relationship between royalty and the cost-price position of each company or firm in the industry. It is important to make this distinction because the relationship of royalty to industry is not necessarily the same as that between royalty and the individual company. A realistic expansionist industrial policy needs to make this distinction, and in the following pages we show why this is necessary. In Chapter 5, we recommend what we consider to be the desirable and consistent royalty base in the context of government policy and development plan requirements.

Given that any system of taxation or rate of tax is designed to achieve or help achieve a certain economic, political, or social objective, as outlined by the government, the main criticism of the current royalty formula is therefore not that it makes the mining companies pay in royalties relatively more in 1965 than they did in 1937. The criticism is basically that:

(a) As an ad valorem tax, the royalty has economic effects which are not conducive to a general industrial expansion programme, i.e. it does not encourage the expansion of the mining sector, contrary to government requirements. This is because the formula, as in all cases of a general ad valorem or sales tax, applies without due consideration of cost-price situations in particular or different mining companies

in the industry. Empirically, this has had the effect of making it difficult if not impossible for high cost mines to remain in business during periods when prices have relatively fallen, or costs have gone up relative to prices. The situation has been particularly acute in cases where a marginal firm or company has also been unable to actually sell its output as a result of difficulties arising from Zambia's economic war with Rhodesia since the latter's UDI.

Moreover, apart from the requirements of an expansionist industrial policy, it may be argued that, morally, enterprises of different endowments should be treated differently. Indeed, government policy on tax reform states the need for equitable treatment of the tax payers. Perhaps in no other line of economic activity would the principle of equity (both horizontal and vertical) be more relevant than in the mining industry. It is especially relevant because it is also consistent with the industrial expansion policy of the government.

(b) From the point of view of the industry as a whole, the formula results in government revenues which are not properly related to the actual capacity of the industry to yield the particular revenues. This arises from the fact that the price in the formula at which the ton of copper is assumed to be sold, is not, in recent times, the price at which the Zambian industry sells its product. Thus we noted earlier that from the 1950's to April 1966, there operated in one form or other some producer stabilisation scheme. That is, there were always two main copper prices - one at the LME, and another for the producer market. Even today, the LME prices at which Zambian producers sell their copper are not identical to those on which the Zambian royalty is computed. Thus, for the industry as a whole taxable "capacity" would be defined, in our case, in terms of the value of copper on the basis of producer prices or prices at which Zambian companies sell their copper [2].

Since our main interest is with the taxable capacity of the company rather than the industry, a desirable definition would take into account not only the price at which the product is sold, but also the cost situation of the different companies. This is the essence of our objection (a) above.

Using hypothetical data in the attached Table 16 A and B, we elaborate concisely the two criticisms above. Table A elaborates the first criticism, showing how the tax may affect companies of different cost structures. Notice particularly the relationship between royalty and a company's gross profit at various LME prices. It is interesting to observe that at a price of £250/LT royalty constitutes about 32.25% of company A's gross profits, and about 51.6% of company B's. But the same amount of royalty, i.e. £25.8/LT results in a loss of about £15.6% for company C! The moral is simple, loud, clear: the higher the company's costs, the heavier the weight of royalty tax. That is, this system of taxation means that the percentage of gross profits received by the Government of Zambia in royalties (and other taxes) rises with the costs of the company taxed.

Recent (1966-68) industrial and employment problems at Bancroft and Kabwe mines have arisen principally as a result of this phenomenon (at Kabwe inherent technical difficulties were more central to the problems). Indeed, in recognition of this anomalous effect of the royalty, the government found it necessary - we would say desirable - to exempt some of these high cost mines from paying royalty (at least for a while). Kabwe mine actually received a royalty rebate from the government.

Now consider Table B. The results of the two prices on the basis of the current royalty and expert formula are recorded in rows 6 and 7. (The inclusion of the expert tax formula does not detract from the main argument). Notice that when the taxes are assessed on the basis of the LME, government revenue from this source is consistently higher over the whole range of prices than when the basis is the producers'

TABLE 16

A.

COPPER MINES - REVENUE, COST, PROFIT.

(£/LT)

LME	250	275	375	500
ROYALTY	25.8	29.1	42.6	59.5
EXPORT TAX	-	-	30.0	80.0
COST A	170	170	170	170
Gross Profit	54.2	75.9	132.4	190.5
Income Tax	23.0	32.3	56.3	81.0
Net Profit	31.2	43.6	76.1	109.5
COST B	200	200	200	200
Gross Profit	24.2	45.9	102.4	160.5
Income Tax	10.3	19.5	43.5	68.2
Net Profit	13.9	26.4	58.9	92.3
COST C	240	240	240	240
Gross Profit	15.8	5.9	62.4	120.5
Income Tax	-	2.5	26.5	51.2
Net Profit	-	3.4	35.9	69.3

TABLE 16

B.

COPPER MINES - REVENUE FROM ROYALTY AND EXPORT TAX

(£/LT)

1.	LME	400	450	500	550	600
2.	P	350	400	450	500	550
3.	C	220	230	240	250	260
4.	G(=LME-C)	180	220	260	300	340
5.	G' (=P-c)	130	170	210	250	290
6.	R+Et (i) LME	86	112.75	139.5	166.25	193.0
7.	R+Et (ii) P	59.25	86.0	112.75	139.5	166.25

Key: LME = London Metal Exchange Price

P = Price at which Producers actually sell their copper

C = Cost of Production per ton

R+Et = Revenue, sum of Royalty and Export Tax

price. The LME average yield of 139.5 represents an increase of around 24% over the average yield using the producer price (Average = 112.75).

Of course this result derives from the fact that we assume a consistently higher LME price compared to that of the producer. A different assumption would yield different results. But the assumption is not unrealistic. As reference to the preceding Chapters will show, the tendency of the producers has been to sell their product at a price lower than that ruling at the LME. The arguments for and against high or low prices are well-known. Our concern in this discussion is purely to point out that so long as the current formula operates the way it does, it will always give spurious results if the LME and the Producer prices remain different. And then either the government or the mining companies get more out of it or lose by it.

This situation is evidently unsatisfactory and must be unwelcome to all concerned.

Having pointed out these short-comings of the current royalty formula, it is only fair from the point of view of government revenue to note from the two tables above the following

(a) the sensitivity of overall government revenue with respect to the copper price movements on the LME.

(b) the amount of revenue due to royalty and export taxes. (This point is stressed more fully in Chapter 2 with respect to the role of royalty and export taxes in helping carry out the country's development plans during the Plan period 1966-70.)

It is legitimate to point this out in order to appreciate the fear that government might have in introducing a new formula. That is, the Government may feel, rightly or wrongly, that the "right" amount of revenues from royalties (and export taxes) with respect to total or

overall government revenues, cannot be more or less than the current yield from this source. This may be dictated by the requirements of other plan objectives.

Our reply to this apprehension is that it is not necessary, at any rate in this instance, to run contrary to one objective in order to attain another. So long as taxable capacity in the country as a whole is still under-utilised - and it is still under-utilised in Zambia - it is possible to achieve both a constant level of government revenue and a desirable structure of mine taxation. In principle, to achieve this position it is necessary only to vary and gear the tax structures (new, old and reformed) appropriately. Thus, we emphasise in our appraisal chapter that the application of our royalty need not have adverse effects on the overall government revenue requirements. In effect, the requirements of both sides, i.e. government and industry, can be shown to be quite consistent from both fiscal and economic considerations.

But first a word about the other two forms of mine taxation - i.e. Profits and Export taxes.

B. PROFITS (INCOME) TAX

The corporation tax in Zambia is progressive. It is about 38% for income up to about £100,000 and 45% above that income level or operating profit of a mining company.

Distributed corporate earnings are taxed at the personal level on the basis of total income when such earnings are received by residents within the country. The personal income tax is also progressive. Thus, for an unmarried person non-taxable income is £450, but for a married taxpayer it is £960 (i.e. more than twice the size of abatements to a single person).

However, dividends are not taxable if and when they accrue to persons outside the country (although the dividend received may be subjected to taxation in the country in which the dividend is

received).

The rules governing depletion and capital allwoances are contained in various sections of the relevant schedules of the income tax law.

Thus, the rates at which depletion allowances are made are defined in Zambia by Part (vii) of the Fifth Schedule to Section 33 of the Income Tax Bill, 1966 (i.e. paras. 24-26 of the Section) (3). The law does not provide for depletion allowances for copper, but provides for depletion allowances in respect of gold and silver mines at 10%, coal mining at the rate of 5%, and all other minerals mined at the rate of 2½%.

Special provisions also apply with respect to redemption allowances. The term "redemption allowances" is defined by the Zambian law to cover:

(a) depreciation allowances of productive equipment

(b) allowances on pre-production outlays not exceeding £100,000 in any charge year or fiscal year, i.e. 1st July of one year to 30th June of the next year.

The pre-production outlays include expenditure undertaken to acquire the right to mine minerals in Zambia, e.g. expenditure on surveys, boreholes, trenches, pits and other property and exploratory works.

The rules governing redemption allowances are of particular importance to us because of the relevance they have in respect of the small mines royalty policy which we present subsequently. The major provisions of the existing law are contained in Part (vi) of the Fifth Schedule to Section 33 of the Income Tax Bill, 1966, thus:

(1) If the building of a mine may also be classified as an industrial building or if implements, machinery and plant of a mine may also be classified as industrial equipment, the mine owner or operator may irrevocably opt to have these properties treated under Parts (i) and

(ii) of the Schedule. He can then claim initial allowances (before first use) of 10% for industrial buildings and 20% for implements, machinery and plant. He can for any year of use claim a wear and tear allowance, which is 5% for industrial buildings, 30% for heavy self-moving mechanical apparatus, 20% for other implements and plant.

(2) Where the preceding option is not made use of, the whole of the income from mining operations is entitled to redemption allowance under Parts (vi) and (vii)

(3) The rules for redemption allowances are drawn up to cover seven different cases as follows:

RULES OF CAPITAL REDEMPTION

CASE I: Mines operated by owning company (par. 18 of the Fifth Schedule)

The capital expenditure to be redeemed in any charge year is the amount of unredeemed capital expenditure at the beginning of the charge year plus the capital expenditure on the mine incurred during the year. This aggregate amount is divided by the number of years remaining in the approved estimated life of the mines. (The approval is given by the Commissioner of Taxes). The resulting quotient is the redemption allowance for the charge year. The unredeemed capital expenditure includes pre-production expenditure on surveys, boreholes, development, interest on loans used for mining purposes and expenditure on building, works, equipment, shaft-sinking and premia (rents) for the use of buildings, works and equipment.

There is an upper limit in the above estimated life of these mines. In the case of lead and zinc it is ten years, and in the case of copper and other mines it is twenty years.

CASE II: Mines operated by companies which are not the owners.

CASE III: Mines owned or operated by partnerships, sole-proprietorship and other "non companies".

The rules for both cases II and III are identical. The Commiss-

ioner of Income tax above determines the redemption allowance permitted in any charge year, unless the non company owner of the mine delivers an estimate of the mine's life of which the Commissioner approves. In that case the redemption allowance is exactly the same as for Case (I).

CASE IV: Non-contiguous mines, currently non-producing which are owned or operated by the owners or operators of a currently producing mine.

The owner or operator of a non-contiguous mine who is not producing from this mine in any charge year, but is producing from another mine is permitted to deduct a redemption allowance in respect of capital expenditure on the non-contiguous mine from the income of the producing mine.

CASE V: New Mines.

A new mine is defined as any independent workable mining undertaking which first commences production after 31st March 1953 or has been re-opened and re-commenced production or has changed ownership and was re-organised with substantially new development and plant and commenced regular production after 31st March 1953. Suppose the estimated "life" of the mine to be five years. The redemption allowances will be calculated as follows:

For the first year: Total capital expenditure up to the end of the year divided by five. For the second charge year, unredeemed capital expenditure at the beginning plus capital expenditure during the second year divided by four. For the third year, unredeemed capital expenditure at the beginning, plus capital expenditure during the third year divided by three. For the fourth year, unredeemed capital expenditure at the beginning, plus capital expenditure during the fourth year divided by two. For the fifth or final charge year, the redemption allowance is equal to the sum of the unredeemed capital expenditure at the commence-

ment of the year plus the whole of the capital expenditure during the year. For subsequent charge years: the whole capital expenditure during the year.

CASE VI: Mines where operations have permanently ceased.

The permanent cessation of the operations may be due to the expiry of the life of the mine or to the termination of the concession. The closing of the mine may be quite unexpected. Technical difficulties may have caused the cessation of the operations or the concession grantor may have the right to terminate the concession without or at short previous notice.

These instances illustrate why the remaining life of the mine could not be estimated ahead of such happenings. This is the chief reason for the special provisions for calculating redemption allowances.

The allowances are calculated as follows:

Consider cessation of operations in the seventh year of the active life of the mine. The unredeemed capital expenditure at the beginning of the sixth year, i.e. the year preceding cessation is ascertained. To this is added the capital expenditure incurred during the last six years of operation. The sum is divided by six and this equals redemption expenditure for each of the six years preceding the cessation. Apparently if, in fact, a different redemption allowance was made during any of the six years preceding the cessation, because the cessation was not anticipated when it occurred, a retrospective re-assessment of tax liability would have to take place.

CASE VII: Mines which change ownership.

The special provision necessary for this case is the likelihood that the payment made for the mine by the new owner is not identical with the unredeemed capital expenditure incurred by the previous owner and claimable by him at the end of time of the change of ownership. It is possible that the payment for the mine is far in excess of the

unredeemed capital expenditure. In this case the payment for the mine would be equal to the replacement value of the building and equipment plus the agreed value of the ores in the ground which includes capitalised excess profits during the remaining life of the mine. It is equally possible that the consideration paid for the mine is far less than the unredeemed capital expenditure. It is further possible that the new owner of the mine did not pay any consideration whatsoever, e.g. if the son inherits the mine from the father. The Income Tax Law provides that the old and the new owners of the mine should make a statement to the Income Tax Commissioner as to the cost of these assets, which would rank as redemable capital expenditure. In case the commissioner does not accept the Statement, he alone may determine the amount of capital expenditure ranking for redemption.

Having outlined these redemption rules, we now propose to make a rather critical comment on their implications. More specifically, only two aspects of these rules interest us most, as these have a direct bearing on the small mines Royalty policy which we attempt to present subsequently.

The following are the aspects and critique of the redemption rules:

(1) The owner or operator of a mine may opt to claim capital allowances for industrial buildings, implements, machinery, plant and premium connected with this mining operation.

This stipulation in effect treats these capital equipments as if they were not part of a mine and yet if used in another operation they are regarded as part of any such industry. It does also mean that although the owner or operator may opt for these allowances so that he receives an initial allowance at the beginning of the life of the mine of equal to 10% for buildings, 20% for implements, machinery and

plant, no such initial allowances are granted to him if he does not exercise the option. Presumably this is to simplify accounts for purposes of taxation. In effect, however, the stipulation discriminates, a priori, in favour of industries other than mining. Again this is contrary to established government policy on the development of mines.

(2) Pre-production capital expenditure and capital expenditure creating new mining capacity are treated equally. The two expenditures are added together and together entitled to capital redemption.

In fact, however, these expenditures are of a fundamentally diverse and different nature. The pre-production expenditure is of the nature of a gamble. It may not result in the discovery of any mineable ore body at all. Its amount per ton of ore eventually mined is completely unpredictable, and may vary enormously from one mine to another. Yet if the pre-production expenditure were not undertaken some resources of the country would not be discovered at all, and others may be discovered much later than is desirable. It is in the interest of Zambia to provide the maximum encouragement to undertake this pre-production expenditure.

The stipulation in paragraph 17, sub-section (4) of the fifth Schedule is not entirely consistent with Government mine development policy. It says that the excess over £100,000 in any charge year of pre-production expenditures "on surveys, boreholes, trenches, and other property and exploratory works undertaken to acquire the right to mine minerals" is not eligible for redemption allowance. This stipulation imposes two limitations on pre-production expenditures. First, that pre-production expenditure must not exceed £100,000 in any charge year. This seems to assume that mine owners and operators are reckless with expenditure on exploratory works. If so, at least part of the fault must lie with the supervisory provisions of the Ministry or Department of Mines.

The main objection to this stipulation is not so much that it restricts allowable ~~deduction~~ expenditure to a maximum of £100,000 - some form of expenditure control would be necessary in practically every case where huge public funds are involved - but that it makes no comparable allowances for the subsequent stage of mine development. Thus, in prescribing "expenditures on exploratory works undertaken to acquire the right to mine" as the only ~~deductible~~ deductable expenditures, in effect the stipulation restricts ~~deduction~~ allowance to prospecting expenditure only in areas held under prospecting licenses. As soon as a special grant is obtained, which conveys the right to mine, such prospecting expenditures as will have been incurred would not be included ih the ~~deductible~~ deductable expenditures.

While the large mines may not be deterred in their effort to develop the mines because of this condition, the small miner is likely to be severely restricted in carrying out the actual process of mine development. It is not unlikely that the small miner's little capital will all have been spent in exploratory works. By the time the mine prospect is ready to be exploited, the shortage of capital would mean that the prospect would be abandoned, implying a worthless expenditure of effort and capital which would otherwise have been profitable in the long-run.

These observations also indicate why it is necessary to separate pre-production expenditure from capital expenditure to create productive capacity. There exists so much knowledge about mining and metallurgical engineering that the risk element involved in the latter type of capital expenditure is small compared with the risk involved in the pre-production capital expenditure. This means that ~~where~~ are expenditure deductions allowable, these would be greater for pre-production than for productive capital.

With reference to Zambia, the Government is determined to encourage small and medium mines as much as possible for very good reasons. First, one expects that as the mining engineering Department of the University of

Zambia produces African mining engineers, many of them will venture to set themselves up as independent mine owners or operators. In a sense, this would be one of the most desirable and exciting ways to encourage African entrepreneurship. Secondly, the example of South Africa and Southern Rhodesia shows that a viable medium and small mines policy can help to attain an optimum utilization of the mineral wealth of a country. In Zambia practically all mining relates to lead, zinc, vanadium and copper; but in South Africa and Southern Rhodesia the whole range of minerals are being mined. The same development can be expected here in Zambia once the engineering knowledge is widespread and exploited by both large and small miners.

As well as engineering knowledge, however, the availability of capital is a crucial factor. As implied above, rapid development of small mines is bound to be impeded by the scarcity of capital. The prospectors and developers of small mining locations will have run out of capital by the time the ore bodies discovered by them have been proved. These small prospectors and developers would have to sell out to others the rights to mine because they have no capital left. This is one main reason why we suggest that the prospectors and developers should be allowed to recoup the pre-production capital expenditure at least in the first few years, say two years, of production in one way or another. They would, for instance, be excused from paying royalties, export tax or the profits tax to enable them to recoup expenditure.

Needless to say, we incorporate these proposals in our small mines (Royalty) policy.

C. EXPORT TAX OR DUTY:

The Copper Export tax formula reads 40% (P - £300) for every long ton of copper exported, where P is the average LME price for the month of reckoning. This tax, it will be recalled, was introduced in April of 1966.

In effect this export tax formula operates as a progressive sales tax. In this sense, it has economic effects similar to those arising under the royalty tax. We noted that a general sales tax is indifferent to the particular cost positions of the firms in the industry. A brief example will demonstrate, once more, our objection to this form of taxation in so far as it is levied on a producer industry like the copper mining industry of Zambia, where the various producer companies operate under different cost conditions.

Assume two companies A and B. The cost of company

A = 200

B = 250

If the price per ton of copper equals £500, then the export tax equals £80. This represents 26.6% of A's gross profits paid as export tax, and 32% paid by B. That is, the tax rises with the rise in costs of different companies.

The rationale for introducing the export tax in April 1966, as we know, was the Government's desire to siphon off excess profits which, at the time, the mining companies were making as a result of relatively high LME prices at which they were now selling their copper (having abandoned the producer stabilization scheme). If so, it may be argued that the Government could have achieved the same result by merely adjusting the profits tax appropriately. Indeed it can be demonstrated that a profits tax has less disincentive effects on the production possibilities of the various producer companies. This follows from the fact that the tax is normally based on <u>net</u> profits i.e. on the residual income of a business enterprise. The weight of the tax is relative to the cost position of each individual firm. This is the essence of a proportional profits tax, which the Government could have used in this case.

It is also true, however, that a sudden imposition of a profits tax or a change in the structure of the existing system of profits taxation, might

conceivably result in political outcries against the Government. Indeed, given the comparative economic effects of the export duty on the one hand, and the profits tax on the other, it seems legitimate to presume that Government choice for an export tax of this nature was largely motivated by political considerations. Moreover, this was made even more feasible by the fact that at the prevailing level of prices and costs, the effect of the tax at the margin of production would not be appreciable. So that from both economic and political considerations, the export tax can be seen to have been a reasonable choice of the Government.

The tax was obviously a useful or practical short-term device from the point of view of the Government. But in the long-run, the Zambia Government and the mining industry will need a tax based on a more economically rational consideration. As pointed out above, the export tax, like the royalty tax, has economic effects which are not desirable from the point of view of both the Government and the mining industry.

From these considerations, the need for reform of the export tax is as self-evident as that for reforming the royalty. This is the task of our Chapter 5.

CHAPTER 4

REFERENCES AND FOOTNOTES

1. See Appendix 1 and Appendix 2 of this work, for contrast.

2. In our system the price used for computing royalty is based on the price at which the producers sell their product. See Chapter 6, Section 1.

3. See Appendix 1, esp. sub-sections 3-6 inclusive, for contrast.

CHAPTER 5

TAXATION FOR ZAMBIA MINES: DETERMINING THE BASE FOR ROYALTY TAX

The base of royalty payment we propose is such that it takes account of all the critical cost factors related to the total production or gross value of the enterprise. In contrast to the current royalty system, our formula is dynamic and specific to individual companies paying the tax.

We begin by stating the principles and considerations relating to the determination of capital value in general. In Section 2 we prescribe conditions under which the Government may make a maximum claim of royalties payable by the mining companies.

SECTION I: DETERMINATION OF CAPITAL VALUE: PRINCIPLES, CONSIDERATIONS:

The term "actuarial valuation"(1) refers to the mathematical (or arithmetical) processes by which the physical quantity of an economic project is translated into financial values. Actuarial valuation may take place or be solicited for a number of reasons. It would be necessary to valuate a project, for instance when a change of ownership is being considered either by outright purchase or sale, or through consolidation with other properties, and sometimes it is needed when funds are to be solicited for through sale of stock or bonds or by bank loan, or when planning a broad revision of operating methods or installation of important, long-life equipment. The appraisal may also be undertaken for purposes of real estate taxation.(2) In all these cases only a financial unit has meaning, and on it alone can an economic decision be taken to change property ownership, to invest, or to devise an appropriate tax structure.

Consider for instance the valuation of a mine per se. The ultimate value of a mine depends on the profit that can be obtained by the extraction and sale of the ore over and above the return of the capital invested in the property. This is the value to which the actuarial value

must be approximated. Now in order to approximate this final figure at any time during the life of the mine future profits have to be estimated and then translated into their actual worth at the time the valuation is made by discounting them to a present value at a predetermined rate of interest.(3)

This present value figure is the crucial indicator for all economic purposes for which valuation may be solicited. It is particularly crucial for investment decision making in a mining programme. A mine is a wasting asset: hence each individual dividend represents not only the interest on the investor's money put into the mine, but also a partial return of his invested capital. By the time the mine is exhausted the investor should have had returned to him the money he contributed to the venture together with the interest on that money while it was in use. It is necessary therefore to set aside such a portion of each dividend that, at a given rate of interest, the annuity thus created will, when the mine is worked out, equal the capital invested at a normal profit.

This practical view point would also be an important factor in any exchange of property. It is invariably the viewpoint taken by a prudent investor in a mining enterprise.

The actual methods of discounting future profits to present value range from simple to complex and may differ between countries and from one period to another as valuation techniques advance or change. However, presently it is generally agreed that the straightforward single rate discount method, in addition to being simple, adequately takes account of all the crucial factors in assessing the capital or present value of a property.(4)

In any discount system for computing capital value, the fundamental parameters of a project are the proposed output, the expected cost, and the expected price of the output. The change in magnitude in any one of these, holding others constant, necessarily alters the capital value of the project.

Stating the matter simply, gross profits are calculated for the whole period of the life of the project. From this all costs are deducted and a net profit obtained for each future year. Among these deductions are, for instance, depreciations, taxation and depletion. A further deduction would also be made of pre-production costs where these existed, e.g. expenditure on shaft-sinking, buildings, etc. The discounted expected net profits together constitute the capital or present value of the project. This is the purchase price or the amount which if invested today would be repaid with commensurate profits by the end of the actuarial life of the property. It also represents the discounted sum of each and all those dividends, after allowance for any estimated further capital expenditure or necessary works and equipment.

With the aid of a single rate discount system, we may clarify this point as follows. Let us suppose for this purpose that the life of a capital project is estimated as five years, and that the expected annual receipts for each of the five years are as follows: a net profit stream of £2,000; £2,500; £3,000; £1,500; £1,000. Then the capital value of this terminable receipt stream is the sum of all these receipts at the end of each of the next five years, discounted back to the present moment; discounting consists of multiplying the receipts of each future year by the appropriate power of the discount rate or ratio.

For instance, the present or capital value of £2,000 at the end of the first yeqr will be that sum of money, which, if invested at a stated or current rate of interest would grow to £2,000 in one year. If the rate of interest be 5%, the following formula would give the discounted value X of this receipt, viz:-

$$x = 1 + 0.05 = £2,000$$

$$x = \frac{1}{1.05} = £2,000$$

The discount ratio in this case equals 0.95238, $(\frac{1}{1.05})$. Multiplying the expected income stream in the first year by this ratio we obtain the present or capital value of £1904.76. This is the sum which would grow to £2,000 if invested for one year at a rate of interest of 5%.

Similarly, the receipt of £2,500 can be transformed into present value by multiplying it by the discount ratio for one year, and multiplying the result once more by the discount ratio for one year. That is, the present value of a sum receivable at the end of two years is that future receipt multiplied by the square of the discount ratio. In fact, the principle of the single rate discount system is that the present value of any future sum of money is that future sum multiplied by a power of the discount ratio equal to the number of years elapsing between now and the receipt of the sum. The mathematical formulation(5) of this principle is stated as:

$$P = \frac{V}{(1+r)^n}$$

where P = Capital or present value
V = Expected future income
r = discount rate or interest rate
n = number of years of annuities

Applying this principal to the net profit stream over the five years in our example, the capital value of this net profit stream can be written thus, where d is the discount ratio and k the capital or present value:

$$K = 2000d + 2500d^2 + 3000d^3 + 1500d^4 + 1000d^5 = £8781.43$$

This mathematical statement says that if £8781.43 were invested today at the rate of d=5% per year the annual withdrawals of £2,000, £2,500, £3,000, £1,500 and £1,000 would exhaust that sum at the end of the fifth year. In other words, the present value or purchase price of the expected income

stream over the five years is this sum at 5% per year.

This is the general principle of the single rate discount method and the way in which it is applied to determine the capital value of a property. The capital value of a mining programme can similarly be determined, giving due cognizance to the nature and implication of pre-production costs.

Take for instance a copper mining prospect. We have stated above that the value of a mine depends on the value of its ores in the product market after allowing for all attendant costs. If we know the total quantity of copper that can be recovered from a certain copper ore body, then we can arrive at the value of this ore as follows: ascertain the value of refined copper at the overseas point of consumption. From this value subtract the intervening costs between the consumption and the mine points, the cost of extraction and refining, and the pre-production outlay. The result is the value of the mineable ores in the ground. Dividing this by the number of tons of ore, the price per ton of ore in the ground is obtained.

Suppose that the ore will be mined over a five year period as follows:

1st year	10,000 tons
2nd year	20,000 "
3rd year	3,000 "
4th & 5th years	2,000 "

A receipts stream for the mined ore over the whole of this period is obtained by multiplying each of these five tonnages by the expected ex-mine price and netted by subtracting all appropriate costs during the year of extraction. To obtain the capital value or present value of this mining programme each of the five items of the net receipts stream is then discounted back according to the discount rule.

The process of discounting the capital value of the relevant pre-production costs is the reverse of the procedure just described above. The term pre-production outlay covers all sorts of costs incurred before the actual extraction of ore could start. Such various fees and costs will be incurred over a period of time. They are not estimated or expected future costs; these are funds already sunk in the venture. Therefore their present value must be obtained by cumulating these expenses forward at a compound rate.

Suppose that there were three items of pre-production expenditures, viz:-

£3,000	three years ago
£2,000	two years ago
£5,000	a year ago

The present value of this stream of past expenditure is the sum of money to which these three expenditures would have grown inclusive of interest up to the present moment. If the rate of interest is 5%, then the last year's expenditure would have grown to £5,000 x 1.05 = £5250. And the expenditure of £2,000 two years ago would have grown to £2,205; the £3,000 three years ago would have grown to £3,000 x $(1.05)^3$ (=1.157) to yield £3472.87. The present value of these three pre-production expenditures would therefore add up to £10,928 = £5,250 + £3,473.+ £2205.

Thus to calculate the present value of pre-production expenditure we simply reverse the original backward discount formula. That is, for this type of cost, the capital value formula is:

$$V = P(1 + r)^n$$

Where V = present value of pre-production cost

P = Actual past expenses

r = discount rate

n = number of years to date

By taking account of all the relevant cost factors in the two ways described here, the capital value of the ores in the ground is finally determined. This is the value of the mine to the owner of the mineral rights. For instance, if the mineral rights were owned by the State, the whole of this value would be payable to the State.

SECTION 2: CAPITAL VALUE OF MINEABLE ORES: MAXIMUM ROYALTIES CLAIMABLE BY THE GOVERNMENT OF ZAMBIA.

We have seen how the capital value of a mine may be derived in general. In every case, the starting point is the value of ore at the (overseas) point of consumption. But the value of ore can only be determined as part of the value of the final product (metal) for which it is an input.(6) As pointed out in the preceding section, the estimated supply, price, and cost are crucial factors in determining this value. But once determined we can express this capital value in terms of value per ton of metal (since we will have ascertained the tonnage to be mined over the specific time for which the value estimates have been made).

To arrive at the value of ores, the process of determination can be presented as follows: the value of the metal at the (overseas) point of consumption is designated as item (1). This is the estimated gross value or total receipts of the enterprise and which must now be discounted to give the capital value of the property or mining programme in question. We must thus allow for all the critical attendant costs which are also appropriately discounted to their present or capital values. The critical costs are all those costs which, if not adequately allowed for would cause the mining production programme to become inefficient or even inoperative in the long run. Strictly speaking the relevant costs are therefore factor input payments plus all the other payments which the Government require the mines to make. The royalty can be levied on part or the whole of the residual net capital value

of this mining programme (see attached Schedule).

In general, this process involves capitalization of receipts and costs and deducting one from the other to arrive at the capital value of the mineable ores in the ground. Thus, as against item (1), we shall say items (2) to (9) in our computation schedule comprise these costs. Note, however, that items (2) to (8) in this schedule are multiplied by a compound factor. This is explained as follows: take, for instance, deduction item (2) i.e. the export duty on refined metal. At present only copper exports are subjected to this tax (by the formula 40% excess of LME price over £300). Thus, if the LME price is £450, the duty amounts to £60. This duty is payable to the Government in the month of production. But the sale of the product is not necessarily effected within the particular month.

Suppose then that the mining company itself has to wait on an average 90 days after it has paid the export duty before it received payment for the refined copper from the customer abroad. This period of waiting is technically called the "standard days of credit". In practice the company would not pay or use its own share capital to finance the 90 days of waiting. That is, the company would borrow finance to pay the export duty while it awaits payment or receipts for its product. The company would then repay the loan at a borrower's risk rate of interest for the 90 days. Suppose that the borrower's risk rate of interest (b.r.i.) per annum is 8% (= 0.08). Then the interest cost of 90 days waiting before the lender could receive the (export duty) loan repayment from the company would amount to:

$$(£60)\ (90 \text{ days}) \times \frac{0.08}{365} \text{ days}$$

$$= (£60)\ (0.019)$$

$$= £1.184$$

$$= \underline{£1.\ 3s.\ 8d.}$$

This credit cost can be added to the export duty by the simple formula:

COMPUTATION SCHEDULE AND PROCEDURE

N.B. s.d.p. standard days in production

b.r.i. borrowers risk rate of interest

n.r.p. normal rate of profit

s.d.c. standard days of credit

(1) Value of a ton of metal at the (overseas) point of delivery to the consumer (e.g. fabricator).

less (2) (Export duty/ton) x $\left[1 \text{ (s.d.c.) } \left(\frac{\text{b.r.i.}}{365 \text{ days}}\right)\right]$

less (3) (Standard intervening cost/ton) x $\left[1 + \text{(s.d.c.) } \left(\frac{\text{b.r.i.}}{365 \text{ days}}\right)\right]$ (Refining to consumption)

less (4) (Standard refining cost/ton) x $\left[1 + \text{(s.d.p.) } \left(\frac{\text{n.r.p.}}{365 \text{ days}}\right)\right]$

less (5) (Standard intervening cost/ton) x $\left[1 + \text{(s.d.c.) } \left(\frac{\text{b.r.i.}}{365 \text{ days}}\right)\right]$ (Smelting to refining)

less (6) (Standard cost smelting concentrates/ x $\left[1 + \text{(s.d.p.)}\left(\frac{\text{n.r.p.}}{365 \text{ days}}\right.\right.$ ton metal)

Less (7) (Standard intervening cost/ton) x $\left[1 + \text{(s.d.c.)}\left(\frac{\text{b.r.i.}}{365 \text{ days}}\right)\right]$ (mining - smelting)

less (8) (Standard extraction and concentration cost/ton metal) x $\left[1 + \text{(s.d.p.)}\left(\frac{\text{n.r.p.}}{365 \text{ days}}\right)\right]$

less (9) Actual pre-production cost/ton metal.

$$(\text{EX. DUTY}) \quad \left[1 + (90 \text{ DAYS}) \quad \left(\frac{.08}{365 \text{ days}}\right)\right]$$

$$= £61.184$$

The compound factors for the deduction items (3) to (8) have to be similarly understood. For each of these items a standard period of credit reckoned in days has to be ascertained. Once the period is ascertained, credit is necessary to finance these costs for the standard number of days (s.d.c.). For these items therefore the abbreviated formula would read

$$\text{Cost} \left[1 + (\text{s.d.c.}) \left(\frac{\text{b.r.i.}}{365 \text{ days}}\right)\right]$$

Note, however that deductions item (4) (refining cost per ton of metal) or item (6) (smelting cost per ton of metal) are multiplied by a different factor that does not contain a borrower's risk interest but instead a normal profit rate (n.r.p.). We may explain this too.

Refining, smelting, concentrating and extracting are the specific mining operations for which a mining company buys implements, equipment and plant with its own capital. In addition it would borrow money to finance entry stock (e.g. explosives), stocks of ores in process (e.g. expenditures on ore in the process of being extracted or concentrated or refined) and exit stocks (e.g. stocks of refined stocks awaiting transport). On all these costs a mining company expects at least a normal rate of profit. Alternatively the profit mark-up could be determined or expressed as a return on total capital investment.(7) This would be the rate of return on capital investment which any efficient firm can earn in the foreign countries from which Zambia obtains her capital.

On the basis of profit mark-up on costs the mining companies would expect to make this profit on all paid out costs and imputed costs. The paid out costs are wages, salaries, costs of purchased inputs (explosives, electricity, coal, coke, drills, etc.). The imputed costs are depreciation

of pre-production capital outlays and capital expenditure on production equipment.

If we take deduction item (4), i.e. the standard cost of refining one ton of metal, and we assume the normal rate of return or profit (n.r.p.) to be 15% p.a., then the normal rate of profit on this item would be: (Standard refining cost i.e. s.r.c.) (Standard days during which one ton of blister is at the refinery i.e. s.d.p.) $(\frac{0.15}{365 \text{ days}})$. From which we may derive a complete formula, thus:

$$(\text{s.r.c.}) \left[1 + (\text{s.d.p.}) \left(\frac{\text{n.r.p.}}{365 \text{ days}}\right)\right]$$

Standard costs as per deduction items (3) to (8) may be defined as the low costs of a normally efficient enterprise, while actual costs may be the high costs of an inefficient enterprise. Thus, we can say that the costs at Mufulira mine are, in this case, the basis of calculation in our schedule. Bancroft mine, on the other hand, would be representative of high cost mines in Zambia. As can be seen, this definition places pressure on marginal and generally high cost mines. In itself it can be argued that this pressure would be desirable if high cost mines are to be driven or forced into finding cost-reducing or more efficient methods of production. On the other hand, the more efficient mines like Mufulira and other low cost mines of Zambia will be the main source of Government revenue, since at the comparatively low level of costs, the emerging residual capital value subject to taxation will increase correspondingly.

Thus the constraint imposed by this definition of standard costs is that it pays to be more efficient or to operate under conditions of comparative low costs, but that inefficiency or high costs in general will not pay. However, high costs do not always reflect inefficiency of operation, but may be due to difficult and inherently costly conditions of operations. Hence this constraint or definition of standard costs may penalise and discourage

the development of potentially dynamic enterprises which are currently operating under difficult and costly conditions. This would not, of course, be the case where such costs would be deductible for purposes of determining the net capital value subject to taxation.

Now, on the assumption that operations are efficient, and that abnormal costs are deductable for purposes of taxation, the resulting tax or royalty is specific to each mining company. On this reasoning, a less complicated and simpler definition of standard costs would be the average costs of each mine. Indeed, the usual procedure in evaluating a mining property for purposes of taxation is to calculate the average cost over a period of (normally) five years for each mine. The rationale for this procedure is that past records of say, production, cost of mining, profits can be expected to give some clue to future production, cost of mining, and profits. A much longer period than five years of past records would often cover phases of the company's history that are not representative of what may be expected in the future. Otherwise the average cost figure is appropriately adjusted to take account of expected changes during the ensuing period for which the valuation of tax assessment of the mine is being carried out.(8)

While accepting the general principle of this procedure, we believe that a more representative figure in this calculation would be the moving average cost in each mine for the specific production process (e.g. concentrating, refining, smelting) during the specified preceding period. This measure is preferable because, as statistical theory will tell us, it modifies untypical variables of a series. The basic information for these calculations would be had from tables similar to the attached.

This base will obviously be more acceptable to miners, especially the high cost ones. This is because the relevant costs for calculation relate directly to the particular mining enterprise. Nor would the low cost mines

TABLE 17A

MUFULIRA COPPER PRODUCTION COSTS (£/LT DELIVERED TO BUYERS)

(Financial Year ended June 30th)

	1963	1964	1965	1966	1967
FINISHED PRODUCTION	10842	154095	161602	150500	118392
Costs: Mining	55.00	44.53	49.98	59.75	70.11
Concentrating	13.66	12.00	11.66	12.23	13.92
Smelting	9.30	8.78	8.42	10.25	17.49
Refining	8.00	8.19	8.23	8.31	10.81
General Expenses	14.10	10.50	11.52	12.98	18.30

Source: LM/6-11

TABLE 17B

BANCROFT MINES LTD. COPPER PRODUCTION COSTS (£/LT DEL. BUYERS)

	1963	1964	1965	1966	1967
FINISHED PRODUCTION (LT)	43154	32645	23782	36540	32809
Costs: Mining	66.3	93.4	104.1	109.2	102.3
Concentrating	16.2	18.5	16.4	16.0	16.4
Smelting	13.8	14.0	15.0	17.6	18.1
Refining	-	14.6	13.5	13.0	16.0
General Expenses	40.8	53.6	59.5	59.4	63.1

Source: LM/6-11

have anything to lose by this base. In each case, the resulting residual capital value is the maximum available for taxation with least disincentive effects on production and investment activity in general. This is highly desirable and consistent with Government policy on mine taxation and development.

Returning to our computation schedule we may note that only item (9) refers to actual costs. These are actual pre-production costs for such quantity of ores as contains one ton of metal.

Thus, the residuum, after deducting item (2) to (9) from item (1), we have said, is the property of the nation, and can be claimed in the form of a royalty from the owners, or operators of the mine. Under the specified conditions, this residuum represents the maximum amount of tax that could be levied on productive capital without bringing about adverse effects on the level of production, and on the comparative attractiveness of investment opportunities in the mining companies or the industry at large.

CHAPTER 5

REFERENCES AND FOOTNOTES

1. R. D. Parks, op.cit: P 155ff

   T. J. Hoover, op.cit. Part I "Mine Valuation"

2. "Elements of Mining" by R. S. Lewis and G. B. Clark Pp. 359-375

   R. D. Parks, op.cit. P 2 - 3, et al.

   T. J. Hoover, op.cit. P 377

3. On discount Systems; see: A. R. Prest and R. Turney "Cost-Benefit Analysis: A Survey" in Economic Journal Dec. 1965.

   R. D. Parks, op.cit. Pp. 2-3 and P. 155ff

   Truscott, op.cit. - On various Valuation Systems.

   P. T. Flawn, op.cit. Pp. 33-36.

4. As at 3 above, also see T. J. Hoover, op.cit. pp. 329-330; a critique of valuation methods.

5. See Brooman: Macro-Economics, Chapt. 7 esp. Pp. 143-148 et al.

6. R. D. Parks, op.cit. P. 261ff and the Appendix: "The Hoover-Finlay Method", or the "Michigan System of Mine Appraisal".

7. Currently the Zambian mining industry assumes a 15% return on capital as the minimum required to attract foreign capital into the sector. In Chapter 6, section 2, we outline considerations that enter into determining the appropriate discount factor or profit.

8. As at (6) above.

CHAPTER 6

APPRAISAL OF THE PROPOSED ROYALTY FORMULA.

In formulating our royalty principle we will no doubt have touched on several points, and certain germane factors may not have been noted. Thus, in this chapter we attempt to elaborate on and to clarify certain points or issues explicitly or implicitly arising from this principle. More specifically, we do this in order to re-emphasise the need and the realism of such a royalty principle or formula in the context of the economy of Zambia.

SECTION I: THE VALUE OF ORE IN THE GROUND VS. PRICE OF METAL

Suppose the value of the ores in the ground were determined according to our royalty principle. Suppose also that this value would remain unchanged for the period of assessment. Further suppose that the price of copper at the overseas point of consumption actually changed during that assessment period. What would be the economic implications of all these observations?

(i) Assuming an unchanged price of finished copper for the whole period, the mining companies could make higher profits whenever they succeeded in reducing all transformation, marketing, transport and administrative costs. The companies would undoubtedly consider this a healthy situation.

(ii) Assuming the price of copper changes during the period while the transformation, marketing, transport and administrative costs remain unchanged, the mining companies would make increasing profits ("Windfall gains"), as prices rose, and decreasing profits or even losses ("Windfall losses") as prices fell.

Thus, in determining the value of ores in the ground in advance, the government would be ensuring that the mining companies had an incentive to reduce costs, which cost-savings they would be allowed

to retain as efficiency earnings not subject to our tax.

To achieve this it is thus necessary first to compute the value of ores in the ground using a pre-determined price of copper. For this purpose we suggest to compute the median copper price. We would arrive at this price by the following procedure:

(i) the unweighted average spot and forward prices during the last three months could be ascertained. This would come as near as possible to a six month moving average price centred on the last day of the price information. Let this price be denoted by $\bar{X}$.

(ii) the median price for the year just ended is then computed. Let this price be denoted by $\bar{P}$.

(NB. In both (i) and (ii) the length of time over which the series are observed can be varied depending on what is considered appropriate. But too long a period is likely to yield unrepresentative results of the price movements.)

(iii) the median price for the year just beginning or for the purpose of determining our capital value per ton of copper might then emerge as

$$\bar{Y} = \bar{X} - (\bar{P} - \bar{X})$$
$$= 2\bar{X} - \bar{P}$$

Using this price, the value of the ores in the ground is then determined according to our system. Having determined this value, our royalty could then be computed either as the whole of this value or part of it only. This is the amount of tax the mines will be expected to pay to the government throughout the period for which the assessment has been carried out.

At present, government policy on this issue of royalty payment is substantially contained in the Statement of 7th May 1965. The Statement[1] reads:

"(a) the present formula, which was established by the B.S.A.Co. for assessing mineral royalties, should be retained.

(b) Concessions may be necessary in respect of those existing mines operating at a loss, and

(c) that in order to encourage development of new mines, the government is prepared to receive and consider representations for granting special concessions in respect of the new mines.

It is the view of the government that this policy will alleviate certain handicaps which some mining companies are or will be experiencing and will at the same time encourage the opening up of new ones."

Our discussion of the royalties versus the value of ores in the ground indicates, however, that none of the concessions of the government statement spelled out in sub-paragraphs (b) and (c) will be necessary if our royalty system were to be applied. The rules for determining the value of ores in the ground make sure that mines are not operating at a loss because their ore has been valued too high. Reflection shows too that it is not necessary or desirable to undervalue the ores in the ground of say, new mines so as to render them profitable. For one thing, mines are not pioneer industries in Zambia; they have been operating here since 1906 so that more is known about their technology, costs and management problems than of any other industry operating in Zambia. On the other hand the annual or periodical re-determination of the value of ores in the ground should be a guarantee that new mines will not be unprofitable because their ore has been overvalued. It does seem, consequently, that new mines would do well to support the substitution of an economic price of the ores in the ground in place of an inflexible, and, with due respect, out-dated tax.

Business men have been known to resist innovations even if favourable to their own interests. It would not be surprising if some Zambia mining companies would oppose the valuing of the ores in the ground while at the same time clamouring for royalty concessions. This would happen in spite of the fact that the valuing of ores in

the ground would clearly concede to them all they could ask for in fairness and equity. This is the logical consequence of a royalty principle based on the residual value of a capital investment programme. That is, in defining the supply price or the opportunity cost of the productive factors, the principle also establishes the basis of the royalty tax.

The system will not permit a deliberate underprising of productive factors, e.g. labour, in order to restore the profitability (or a relatively higher net capital value) of an inefficient business. And in so far as the royalty is pre-determined, the cost of inefficiency must be absorbed by the particular producer enterprise. This latter constraint ensures that the nation will not be deprived of revenue from such a non-replenishable asset as ores in the ground.

SECTION 2: THE RATE OF PROFIT: CONSIDERATIONS AND CRITERIA

All things being equal, a given rate of profit or return is decisive in our formula because it

(a) determines the net capital value of our mining programme, and consequently

(b) determines the amount of tax levied as royalty on this programme.

Thus, the amount of royalties payable according to our royalty formula will depend on the various rates of profit used to capitalize the whole (expected) income from the given mining project or programme. Since we assume the various rates of profit to be related to the opportunity costs of the relevant productive factors, the present value and the net capital value as well as the royalty based on it will all be greater or smaller according to the amount of profit considered appropriate and allocated to those productive factors.

Otherwise stated, a prospective investor will consider an investment expenditure justifiable if the net yield on that investment project at least equals the rate of "interest" which discounts the

future cash flows of the project into equality with the capital cost i.e. the relevant rate of interest (= profit rate) must be one which results in a zero net present value of the capital project. In effect, this is the discount rate which becomes the relevant rate of profit for the particular investment project, or the entire investment programme.

To illustrate, considerations entering into the choise of a desirable or appropriate rate of profit on investment we suppose a prospective investor faced with two alternative investment opportunities each requiring a capital outlay of 1000 monetary units. He can either invest the capital in a company whose management is sound and in which investment is absolutely safe and the future yield can be guaranteed to be constant; or he can invest it in a company where there is a one-in-ten chance (= risk), not only of not getting any income but of losing the capital during the year (or specified period). In these circumstances, if the first investment should appear to offer the investor an annual income of 50 (i.e. 5%), he will not wish to invest his capital in the other company unless he can get, in addition to the 50 monetary units that he would get from the first, that proportion of his capital which corresponds to the probability of the loss (i.e. one-tenth of 1000). He will therefore want a total yield of 150 monetary units, i.e. 15%. If the actual yield is less than this, all things being equal, the investor will choose the first investment. Thus the 10% differential rate is critical and it is the one that is going to be crucial in the assessment of the capital value of our elected project or programme.

From the point of view of fiscal policy, it is sometimes argued that such a risk premium should not be subjected to taxation because strictly speaking it is not "income" but corresponds more to an insurance premium which the investor might, in theory, pay to an

insurance company to cover himself against the loss of his capital. On the other hand, it is pointed out that even if this were true, the premium income is real once received by the claimant who may accordingly be subjected to a given form of income tax.

The debate goes on. But from considerations of investment decision-making it seems legitimate to regard this kind of differential as representing the amount required to "convert", in our case, the second investment into one like the first. In other words, for this kind of investment a "normal" rate of profit cannot be less than 15% if it is to be sufficiently attractive to our prospective investor.

Moreover, apart from the probability of loss of capital and income, the premium rate may be related to other factors. Thus, suppose there were two alternative projects available, each of which gives the same average rate of yield over a long period. But while one gives a constant income, the other yields a greatly fluctuating income with wide deviations above or below the average. In this case too, the prospective investor decides against the second investment. Here the critical consideration is not the average return on capital over the whole long period. But rather it is the annual returns that will determine whether or not the one project is more attractive than the other. The differences in annual earnings can be employed to advantage elsewhere (either as dividends or investment).in the years before the end of the "life" of the project. Hence a much higher average rate of yield would be required if the second project is to become as attractive as the first.

This means that where capital investment is both risky and yields an irregular annual income, the premium necessary will be correspondingly higher relative to alternative investment returns. Stating the matter generally, no one will be willing to accept a capital risk, or an income risk, without obtaining some compensation or an adequate premium.(2) It is this premium

which determines whether a desirable rate of profit will be 8% or 15% in our computation schedule. The essential point is that the given rate is determined or chosen on the basis of comparative yields of alternative investments. As long as we use observed data, the market rate of return calculated will include risk premium. Therefore it is not necessary for the Government to calculate risk premium separately. This means that in the case where a prospective investor must choose between alternative investment projects in Zambia and elsewhere in the world, the rate of profit realisable on the investment in Zambia must be related to the rate of profit on similar investment expenditure elsewhere in the world. This in fact seems to be the basis on which the mining industry of Zambia assumes the appropriate or desirable rate of profit to be at least 15%.

The assumption is based on the knowledge that mining investment in general is not worthwhile if it cannot yield a return of 15% to 20% or even more. In the specific cases where, as in countries like Zambia risk is not only of an economic, but of a political nature (i.e. nationalisation and general political instability) the expected rate of return in mine investment is even much higher. A more concrete example of this observation is illustrated by the yields of capital investment in some of the South African mines. Of the three best yields in recent years, the highest is 23.2%, followed by a 20.6% yield, closely trailed by a 19.6% yield.(3)

Now, the copper industry of Zambia is to a considerable extent reliant on foreign investment capital. This is a point which it is impossible to overemphasise. In this sense the Zambian industry competes keenly for foreign investment capital, and success means simply offering a rate of return that is better than that offered by competitors elsewhere in the world. When this has been said, it can be seen that a rate of return of 15% would not seem to be asking for too much from the point of view of the industry.

The difficulty of determining an objective rate of profit arises not only from statistical considerations, but also from considerations of subjective valuations of Governments and Company managements alike. Statistically, it is not always possible to say, for instance, that a return of 15% on investment in Zambia is the same thing as that rate of return on investment in Chilean mines. Experts have consistently pointed out that these figures are sometimes not comparable because of the different bases used in calculations in different countries (even in the same country). Hence in saying that a 20% return on South African mine investment is <u>obviously</u> more attractive than a 15% in Zambia, one is presumed to have adjusted for any possible anomalies in the bases and parameters used in these calculations. Otherwise the statement on its own has no content.

Normally, a rate of profit expresses the relationship between capital and income. Sometimes it is necessary to distinguish between a rate of profit on loan capital, or on share capital, or on total capital. In the usual case, the rate of profit reported in company accounts refers to total capital, the majority of which is usually share or equity capital. For purposes of assessing the productivity of capital, the rate of profit refers to the relationship between incremental capital and the net income arising from it.

Quite clearly, the prospective investor is primarily interested not in the return on total capital of the company, but in what his capital will earn if invested in that company. In other words, the critical rate is the marginal efficiency of his investment. Conversely, this is the rate of profit which the company must promise to offer if the investor is to be induced to provide his capital.

In our case, this is the rate of profit which the mining companies of Zambia must promise to capitalists if capital is to flow into this industry. However, the problem always arises because of disagreements between the

Government and the industry. It is usual for the companies to assume a much higher rate than that assumed by the Government. The companies do this because it is in the interest of their shareholders and other investors to use a high discount rate of profit. On the other hand, a low rate of profit ensures that Government revenues from company profits will be relatively higher. In developing countries the issue is both political and economic since most of the capital is foreign owned and to allow a much higher discount rate than is "necessary" would be unpatriotic as well as deprive the country of the much-needed development resources. This is because any investors' profits would largely accrue outside the host country.

This stalemate evidently calls for some form of objective system for determining the desirable rate of profit from both industry and Government point of view. This is particularly desirable in view of the fact that countries like Zambia compete keenly for the supply of international capital. Some such system would be useful in determining what a competitive rate of profit will be on investment in Zambia.

One simple system would be to construct a rate of profit from past records of investment yields in the Zambian industry. (In fact this is precisely the basis of modern techniques in forecasting or determining the desirable rate of profit except that in this case the information is fed into a computer for analysis and results). To the extent that this can be done an average net profit could be computed over a specified period, say two to three years of past records. To the extent that the capital market is highly competitive, this rate of return would approximate very closely to the supply price of capital in a perfectly competitive market. Our main interest in this calculation is to attempt to provide a bench-mark from which both the Government and the Industry could begin to bargain about what was thought to be the desirable rate of profit. In other words, the final or actual rate of profit selected would be a modification of this computed rate in the light

of current and expected market trends.

This approach must have particular appeal to the Government since it will now be left to the mining companies or the industry at large to prove why the computed rate of return cannot be applied in discounting the particular investment programme.

The table below indicates the basic approach implied by our simplified system:

Year	C	Mc	Ty	My	$\frac{Ty}{C}$	$\frac{My}{Mc}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	1000	1000	50	50	5%	5%
2.	1200	200	300	250	25%	125%
3.	1500	300	340	40	22.6%	13.3%
4.	1900	400	400	60	21.0%	15.0%

C = Total capital

Mc = Incremental capital

Ty = Yield on total capital

My = Yield on marginal or incremental capital

The required result is computed from column (7) of our table. In the case where the distribution in this column is not generally constant, a more stable measure may be used, i.e. it may be thought desirable to use a median or moving average rate of profit for the specified period observed.

SECTION 3: FREQUENCY OF RE-DETERMINATION OF PRICE OR VALUE OF ORES IN THE GROUND

The current royalty formula dates back to April, 1937, and has been in operation since, unchanged. This is in spite of the changes brought about by the war and the post-war economic convulsions, including the Korean and the Vietnam wars, and the political emancipation of most colonial territories and their advance towards economic freedom. Of course, as we mention and

emphasise elsewhere, such changes in the economic and political environment would not necessarily require changes in the current royalty formula to take place. Strictly, changes in the royalty formula would be called for as a matter of Government policy in view of the economic and other objectives to be achieved by making the requisite changes.

Nonetheless, to the extent that the current formula is static, it would not come as a surprise if it should be hopelessly out of touch with the economic facts over a long (or even short) period of time. In contrast, our system of royalty payments could never suffer from such a weakness. This is because, once we have stated the objective and essence of the royalty tax, our system allows for a frequent re-determination of the price or value of the ores in the ground. We consider this ingredient as one of the most important in our formula.

Ideally, re-determination should take place as often as:

(i) the price of copper changes

(ii) the standard costs of transformation, marketing transportation and administration, change.

(iii) the export duty changes.

How short the interval between one re-determination and the next should be depends upon cost (and equity) considerations.

To begin with an annual re-determination should be attempted; Practice may show that the interval between re-determination could be increased from 12 months to 24 or 36 months. It is impossible to be certain about this without experimentation.

Suppose, however, that a system of long term price determination is preferred. This would assume certainty of demand and supply conditions over the entire period. Applying the system of mine valuation, the value of the ores in the ground would be ascertained over that period. If so,

the best way to induce incentive to cost-reduction would be to require the mines to pay this royalty as a lump sum to cover the specific period. Thus, for a period of 20 years the royalty payable might be calculated as £10,000. This need not be paid all at once. An instalment system may be devised, say £5,000 at the beginning of the first ten years, and the remaining £5,000 to be paid at the beginning of the second ten years. The main point is that however it may be paid, this sum constitutes a portion of fixed costs over the period.

Two distinct advantages are apparently derived from this hypothesis: the mines can look forward to a long period of planning; and secondly the mines are encouraged to reduce costs since they know that any such cost-savings will not immediately be lost in the subsequent period, e.g. the next year, as standard costs are adjusted to take account of cost changes. That is, for a considerable time the mines, if they can reduce the costs of production, can go on enjoying such efficiency earnings. The system would also ensure a non-variable revenue for the State from the mines for the whole long period.

But the implicit assumption that supply and demand conditions will be certainly known over such a long period (say 10 years) is, of course, highly speculative if not exactly hypothetical. Over a long period the likelihood is that supply and demand conditions will change in such a way that the value of the mineral property and hence that of royalty may be altered drastically. If so a lump-sum hypothesis would imply either that the mines are unduly favoured if during that period the changes in the price-cost relationships have resulted in relatively high profit earnings for the enterprise, or that they have been unfairly treated if, although cost-price relationships have changed in such a way as to result in relatively high costs, the mines have still to pay the lump-sum.

Indeed, the objection to this hypothesis is akin to that which we have already advanced against the system of royalty payment as it applies today. This is that over a long period, prices and costs change. Therefore, unless these chan es are constantly watched and adjusted, an inequitable and undesirable system of royalty is bound to result. It makes no difference to the principle that in the one case the payment is monthly and that in the other it is a once-for-all for the period as a whole. The basic principle cannot be altered by these considerations. Thus, if we desire to determine royalty as a tax consistent with the production possibilities of the enterprise and Government policy, we cannot overlook the supply and demand conditions of the productive factors (labour, capital) for reasons of expediency, especially over such a long period of time. Once we have decided to follow a rational system of pricing we cannot in the same breath opt for an irrational one and then only when such an irrational system favours us.

The lump-sum hypothesis is evidently not consistent with the logic of Government mining policy and industrial productivity in a dynamic market. Thus we believe that in all cases re-determination of values should be as regular as possible. This we recommend with due respect to the enormous problems that are necessarily a feature and part of property valuation, especially mining programmes.

SECTION 4: ROYALTY (= CAPITAL) TAX vs. INCOME (PROFITS) TAX(4)

The essence of our proposed royalty formula is that the resulting tax is a capital tax. As such it has economic effects which are basically different from those that would result from levying say, a profits or income tax on an enterprise. From the point of view of revenue, however, one form of tax may be seen to be as good as another. Thus, if a company has an

income equal to, say, 5% of its capital, the result is the same whether its income is charged at 20% or its capital at 1%. In each case the absolute amount of tax yielded equals 1 monetary unit, given that the capital value in question equals 100 monetary units.

But this is as far as the equivalence can go. In effect, there are fundamental differences between a capital tax and aprofits tax. In particular, the differences arise from the effect the respective taxes have on the allocation of productive factors. For instance because a general uniform or profits tax catches certain items of cost as income(e.g. interest on equity or ordinary share capital), this may cause an internal redistribution of investment by diverting capital from the more hazardous to less hazardous sectors. This element of risk is taken account of in determining the capital value of a project in that the market capitalises, at the given or appropriate rate of discount, the income from the investment net of all costs (including all critical taxes). To this extent the capital tax is preferable from the point of view of encouraging the undertaking of relatively risky investment ventures.

For purposes of illustration, assume two alternative investment opportunities A and B. Investment in A offers 100% safety of capital; investment in B incolves a 10% risk of loss of capital. If the return or yield on A equals 4%, therefore the appropriate rate of yield i.e. the yield necessary to induce comparable investment in B will equal 14% including the risk premium. If the tax is a profits tax at 20%, then the after-tax or net income for B will be 11.2% (i.e. $14 \div (.2 \times 14)$. But since the risk of losing the capital is not reduced, and is still computed at 10%, the actual nominal net yield is in fact reduced from 4% to 1.2% (i.e. 11.2 - 10). Thus the 20% tax on the nominal and uncertain income becomes a 70% tax on the net nominal income (i.e. $100 \times \frac{.2 \times 14}{4}$). And it can be shown that the weight of this tax will become heavier with an increase in risk. On the other hand, this conclusion implies that more secure incomes will be favoured because the

nominal income would be closer to the actual income. To this extent the tax may cause a flight of capital from more hazardous to safer sectors of the economy. This effect would be harmful from the point of view of productivity.

Suppose the tax is a capital tax at 2% and A and B are alternative investment opportunities such that A is safe and expected to yield an income of 5%. Investment risk in B is computed at 10%. If the capital value equals 1000 monetary units, the after-tax or net yield for

$$A = 980 + 50 = 1030$$

$$= \frac{1030 - 1000}{100}$$

$$= 3\%$$

$$B = 980 + 150 = 1130$$

$$= \frac{1130 - 1000}{100}$$

$$= 13\%$$

Here the tax maintains the 10% risk differential necessary to make B sufficiently attractive relative to A. In this sense a capital tax is more favourable to relatively risky sectors of the market.

Moreover, our royalty tax is a special capital tax in the sense that it has a built-in incentive for a more efficient use of productive resources. Thus, once the costings, and the valuation and the tax assessments have been carried out, there is virtually no limit to the extent to which efficiency may be encouraged. This will be especially so the longer the period between one assessment or valuation and another. In one important respect, the success of this incentive claim will depend on the extent to which, at the time of valuation or assessment, the investors or the mining companies reveal genuinely their expectations of the cost trends. Indeed it is in their interest to do so, because what actually happens in the previous period affects the capital value of the investment in the subsequent period.

In other words there is no incentive in over-stating the expected trend of costs at the time of one valuation in order to make "cost-reductions" before the next assessment period. This is one distinct advantage in using past records for calculations in our system. In a sense, as against the incentive factor, we could say that our system also has a built-in control factor.

Given an expansionist industrial policy in Zambia our royalty formula is evidently a desirable instrument available to the Government. It is important only to remember that the tax is being conceived as part of the whole system of taxation in Zambia. So that the overall success of Government objectives depends not only on our royalty tax, but also on other forms and structures of taxation in the mining industry and in other sectors of the economy. Viewed in this light, the implied favourable effects resulting from the application of our royalty principle can be seen to be not entirely hypothetical. In effect, our royalty system is not only preferable as against other forms of taxation, but also realistic in the context of the Zambian development plan, for which we presently recommend its application.

SECTION 5: PROPOSED ROYALTY VS. PLAN OBJECTIVES

As reference to Chapter 2 of our work will show, recurrent revenue will be the most decisive source of resources for implementing the plan objectives of the Government of Zambia for the period 1966-70. It is mainly because of the recognition of this fact that the Government tax policy will require to be constantly reviewed so as to ensure that the necessary resources are marshalled for the specific purpose of attaining the goals of the economic development programme. An integral part of this tax reform programme, as we will remember, is the emphasis on equity considerations, and increase in labour productivity and, naturally, an appropriate increase in treasury funds.

With reference to equity considerations, our royalty proposal will be seen to take account of equitable treatment between enterprises. This is

the logical consequence of the fact that the royalty required to be paid by each such enterprise is specific to that enterprise, having taken account of all relevant factors that influence the enterprise's level or scale of operation. It is also equitable as between the requirements of the Government (revenue) and those of the industry (costs vis-a-vis profitability). This is because our system of royalty payment is based on an economically rational system of capital valuation. This is why, apart from equity considerations, we believe that our system would result in an increase in industrial productivity, which is a main objective of Government policy. To the extent that this would be achieved, it would help the Government to achieve some of its important goals e.g. a maximum participation of the population in the activities of the economy (objective ii), which in turn would result (or be expected to result) in an overall increase in revenue contribution to the national treasury as taxation would then be broadly based. Thus utlimately the capacity of the system of taxation will depend on what changes take place in the existing tax structures and whether new forms of taxation are introduced to help achieve the economy's development goals.

For our part what we set out to do was the examination of the existing tax rates in so far as these relate to the taxation of mines. And the conclusion arrived at is that the existing tax rates imposed on mines, especially the royalty (and the export tax), are not properly based and are basically inconsistent with the (other) objectives of Government policy. Thus, if the Government requires to raise industrial productivity in the mining sector and in the economy in general, then the economic and most effective and efficient way to do this would be to adopt our system of royalty payments. Thus we argue throughout the relevant pages to show why our royalty principle is superior to the current formula which, to put the matter in short, leaves much to be desired. We believe that unless the Government takes appropriate measures to redress the anomalous tax system

it can hardly expect that the ambitious development goals (e.g. £70 m. per annum on public capital investment) would be achieved as well as might be under more optimal conditions such as the ones we postulate in our royalty formula.

With our system we are confident that the development objectives set out in the Plan would not only be achieved, but would be achieved within the framework of economic rationality. Take for instance objective (i) in the Plan. An increase in the productivity of the mining industry following the application of our royalty payments formula would lead to an increased revenue contribution from this sector. This increased revenue would enable the Government to sponsor or personally to undertake (through say, the Industrial Development Corporation - a State owned enterprise) the development of other industrial activities so that ultimately the copper industry in partiuclar is no longer the main or only main employer in the economy. This would mean a higher level of employment opportunities in the economy as a whole; it would also mean a greater proportion of domestic demand would now be satisfied by domestic production from a large industrial base.

As we mention above, all this activity should increase the capacity of the tax system. With this increase in revenue the programme of economic diversification becomes even more real. Thus the prevailing dual economic system (money vs. subsistence economy) could now be minimised (objective v), and from all such various economic activities we would expect, on average an increase in monetary output per head over the plan period (objective iii).

One can visulise a snow-balling effect of all this on the capacity of the tax system to marshall resources in the hands of the government. Thus with an increase in revenue due to all these economic activities which in themselves follow from the expenditure programmes of the State, the State will be further enabled to increase the provision of social infra-structure

e.g. communications (objective viii), and an overall increase in social (or public) investment e.g. to raise the general level of education (objective vi), and to provide more and better living accommodation (objective vii).

The provision of social or public goods i.e. social infra-structure is an important ingredient for a programme of development which emphasises the need of the development of private enterprise. This provides an important source of external economies without which many would-be private enterprises would not venture to enter into economic production.

If we look at our proposed system of royalty payment as only one of the several possible tax structures, we will see why it is consistent with the objectives and requirements of the Government plan. Thus, we mention elsewhere the fact that our system is not an alternative, but rather a complementary structure which enables the revenue of the Government and the cost and productivity of the industry affected to be related in a much more economic and realistic fashion. If our system should result in a smaller liability of tax falling on the mining industry, it is for the good of the industry in so far as this would imply a higher potential to expand capacity, and to that extent it would be in the long-run interest of the Government and the economy as a whole.

In conclusion we can say no more than reiterate that the attainment of all the development goals will depend by and large on the efficiency of the whole system of taxation. Thus, allocation, distribution and stabilization (objective iv) will all depend on what happens to the revenue and expenditure programmes as envisaged in the Public Budget for the period in question. Only we believe that our contribution in this respect would be invaluable, not only in respect of the period in question but also beyond that period.

CHAPTER 6

REFERENCES AND FOOTNOTES

1. See Extract of Statement in File ONDP/6/2/1.

2. See N. Kaldor: "An Expenditure Tax": G. Allen and Unwin, London 1955.

3. Mining Journal, Jan. 30, 1970.
"Supplement" pp. 2-3 esp. P. 105 and as at (2) above, et al.

4. This section is principally based on the findings of the following authors:

E. R. Seligman: "Essays in Taxation": MacMillan, New York, 1925, Pp. 213, 218-219.

R. W. Lindholm: "Public Finance and Fiscal Policy", Pitman, New York, 1950, Pp. 517-518 and others.

CHAPTER 7

ROYALTY FOR SMALL MINES

Before proceeding to make a case for a special royalty to apply to small mines we propose first to define, in our context, the meaning of a small mine, and then to spell out the special significance of small mines in the economy of Zambia.

(A) DEFINITION OF A SMALL MINE

The process of mining itself is defined as any artificial excavation or extraction made from the earth's crust for the purpose of winning mineral values. This definition incorporates both open-pit and underground excavations for metal and coal workings, quarries and oil, gas, salt and sulphur wells, but excludes borrow pits, railway sewer, and water tunnels and, in general, all diggings made for commercial purposes other than the exploitation of minerals.(1)

A mine as such can be defined as small, medium or large in either relative or absolute terms. In the former case, the size of a given mine is compared to the size of the other existing or potential mines. In the latter case, the size of a mine is defined in technical terms with respect to say, its annual tonnage, ore reserves, etc. In both cases, however, the size to which a mine will grow depends largely on the quantity and quality of the underlying ore body on the one hand, and on the costs and prices on the other.

In this paper criteria for defining the size of a mine are given, but only as an aid for purposes of discrimination when applying our royalty system to the various mines. It is therefore not strictly an economic classification in the usual sense. Our basis of discrimination is largely physical rather than financial. It is noteworthy in this respect that some authors (2) have suggested that apart from the big or large consolidations a mine producing around 100,000 tons a year may be regarded as operating at a moderate scale; if it produces

quantities beyond 1,000,000 tons a year, it has a large scale operation. From which observation it may be inferred that a small mine is that whose annual production is below 100,000 tons.

It is informative to observe in this connection that in Chile[3] the law defines a medium size mine as that which produces less than 75,000 metric tons of metallic copper per year but which is not a small mine. A small mine is normally defined in terms of the amount of capital and corporative status of an enterprise. This approach is, of course, also true of the definition of large and medium size mines.

Our own classification of the mines, by size, is as follows:

(i) SMALL MINE

We shall say that a metalliferous small mine is one which satisfies at least one of the following conditions:

(a) Proved ore body of one million tons or less,

(b) A recoverable metal content of 25,000,

(c) An annual output of 5,000 tons of recoverable metal or less

(d) An actual or planned pre-production capital expenditure and output capacity creating capital expenditure of £1m or less.

(e) A total manpower of 250 men or less.

(ii) MEDIUM SIZE

This is the stage between small and large mines. We may therefore identify such as one which satisfies any one of the conditions under "small mine", but somewhat at a higher level. We may, for instance, be more specific and say that a medium mine must exhibit properties (a) to (e) under (i) enlarged up to three times.

(iii) LARGE MINE

Again, as a matter of practical convenience we may distinguish a medium from a large mine by stipulating that a large mine must satisfy any one of the conditions (a) to (e) under (i) at even a much higher level.

(iv) NEW MINES:

The definition of a new mine contained in paragraph 21 of the 5th Schedule to Section 33 of the Income Tax Bill, 1966, may suffice for our purposes, and reads as follows:

"A new mine means any independent workable mining undertaking whether or not operated by a person already carrying on mining operations which

(a) first commenced regular production in the fiscal year just ended,

(b) having previously been in production, had been closed down and had subsequently been reopened and recommenced regular production in the fiscal year just closed,

(c)has changed ownership and was reorganised with substantially new development and new plant and commenced regular production in the fiscal year just closed."

As we can see, mines whether they be small, medium or large, or indeed new, can be alluvial,open-pit and/or underground. However, the definitions given above would apply primarily to open-pit and underground mines.

Alluvial mines are of course the most easily worked mines. No alluvial deposit has so far ever been worked in Zambia. But there is always a possibility of alluvial deposits being discovered and worked profitably. If this were to happen, initially preference could be given to small mines and to cooperative societies, i.e. the State would be well advised to grant mining rights to small operators to exploit the alluvial deposits.

It is perhaps proper at this stage to compare the status of a new mine with that of a pioneer industry. A pioneer industry enjoys certain privileges under Pioneer Industry Act No.55 EX. 1965, which a new mine does not. Of course the main purpose of the P.I. Act is to

encourage the establishment and development in Zambia of new manufacturing and allied industries on a commercial scale. The Act stipulates four conditions that must be satisfied before an industry could qualify for the benefits. These conditions are found under Section 3 (i) of the Act and state that

(a) no similar industry shall be operating on a commercial scale anywhere in Zambia,

(b) there exist good prospects of viability for this industry,

(c) there are insufficient or deficient external economies accessible to the industry to permit it to enjoy full profitability in the early stages of operation,

(d) the industry in question is judged to serve a substantial public interest.

From what we have seen of the definition of a new mine, it is obvious that such a mine is denied privileges that a pioneer industry is allowed to enjoy. This is simply because a new mine, by definition, does not qualify for such privileges under conditions (a) of the P.I.Act. As is well known, there will always be mines of similar stature and interest operating at the same time. In a given country, this is geologically determined. In such a case, if a new mine came into existence it would not have to develop its own domestic or foreign markets, for instance. More specifically, for a country like Zambia the output of a metalliferous mine can always find a ready export market except in times of a slump. Moreover, the mining methods to be used will be fully known and so will, except in special cases, the metallurgical methods needed to extract the metal from the ores.

There simply is no similarity between the pioneer industry and the new mine. In one important respect, however, they have a common feature: both are denied facilities for economic operation in remote areas.

(B) A SMALL MINE: VIABILITY AND ROLE IN ZAMBIA

The question of encouraging individual entrepreneurship in Zambia is one that cannot be over-stressed. And in a country where mining is the industry of the nation as well as being essentially a large scale operation, the opening of a small mine becomes simply a logical necessity. This necessity arises from various public and private considerations which in turn must justify the treatment of small mines as fundamentally different from the large ones. In recognising and accepting this difference the individual and the public, inter alia, admit as natural the establishment of a small mines policy which is distinct from one that would apply to the large mines. There are many reasons for establishing such a policy. We can only mention a few here by way of illustrating the necessity for this policy.

(i) Big mines often make mineral discoveries which might not or do not interest them, though such discoveries would or might interest small mines. Often small miners in Zambia have taken up deposits discovered and partly developed by big mines. If these could be worked profitably only by a large mine, small mines would offer them to the large miner. In all other cases they themselves will work the deposits.

We may, in this respect, quote the development of the mining industry in South Africa and Rhodesia, where the role of the small miner has brought the industry to its present level of activity. In contrast, the industry in Zambia is a big corporation enterprise to which exclusive monopoly rights to minerals were granted over vast territories. Perhaps this explains, historically, the fact that south of the Zambesi river there was a greater rate of mineral discovery per annum, and also a substantial rate of discovery of types of minerals which were never looked at in Zambia. A large part of the mineral wealth of Zambia requires to be discovered, and the encouragement of small mining could help raise the discovery rates to higher levels.

(ii) During the last 40 years[4] or so the whole of Zambia has been several times combed by prospecting companies. However, only small portions have been prospected by sophisticated geochemical methods which are beyond the financial resources of small prospectors. In the old days individuals could concentrate on outcrops. These were always rare in Zambia and most of them have been examined.

It is debatable whether small mines have much chance left to discover payable new mineral resources. They may, however, discover some in which big mines are not primarily interested and others which lie in undeveloped parts of the country, off the line of rail. Little can be more important for the future development of Zambia than that profitable non-agricultural pursuits are started off the line of rail. (Agriculture has always been an unattractive outlet for young talent in the rural areas though its significance to development is undeniable). While sectors like agriculture must continue to expand and to play their role, it is to the small miners that much of this economic development of the rural areas today will be due (e.g. development in Gwembe area since the beginning of coal-mine workings there).

(iii) In general, small mines are labour-intensive and capital-saving. The small mine has usually only limited capital resources and is therefore forced to think of methods of prospecting and exploration and mining which need the least amount of capital. This shortage of capital also forces the small miner to rely chiefly upon local labour in his activities, provided that this does not involve a large amount of working capital. Working in an open agricultural country he is able to make use of and train the local population. Therefore employment opportunities for the local population arise which would otherwise be lacking (outside commercial agriculture).

(iv) Having limited capital and not knowing whether at the end of the revenue-earning life of his present small mine he would find another

commercial mineral deposit, the small miner limits his output capacity so as to prolong the life of his mine. If he can obtain a trainable local labour force he will enlarge the annual output capacity somewhat but he would not over-extend it to the point of causing himself sufferance from a lack of trainable labour reserve.

This apparently conservative attitude ensures a rational exploitation of resources over a relatively long period; and in doing so the employment life of labour is also prolonged, i.e. pay-offs due to lack of employment are made more distant than otherwise.

(v) If there were many small mines in Zambia, their combined contribution to the G.D.P. while only a fraction of the contribution of the large mines, would nevertheless be noteworthy. Every contribution helps to raise the standard of living of the nation, especially in the rural areas.

(vi) As the School of Mining Engineering at the University of Zambia begins to produce African graduates, these will at first be absorbed by the large mines in compliance with the government's Zambianisation programme of manpower in the mines. The time may, however, not be far off when African graduates will wish to become small independent miners. This time could arrive much sooner if the government were to provide prudent credit facilities for the intending small miners to open up the viable small mining prospects. The advent of small independent African miners would materially contribute to a rapid growth of endogenous entrepreneurship.

(vii) As the few existing mines reveal, many of them are re-opened old mines, which did not prove to be of sufficient interest to their original discoverers(5). The small mining technique is therefore a means of saving precious national assets from oblivion. There are of course many reasons why a previously abandoned mine may be worth re-

opening; but it is also true that many of these reasons must be in the new technologies which are open to present day small miners.

(viii) Looking ahead, opportunities for opening up small and medium size mines should present themselves once the two large mining groups in Zambia renounce their unused mining titles and rights which they cannot make use of within, say, the next twenty years. How many of them will contain payable ore bodies the future alone will show. But it will certainly be one of the deeply satisfying, though at the same time most difficult tasks of the Ministry of Lands and Mines, to obtain the release of unused mining titles and rights from the big mining companies. The declared policy of the Zambia government is not to do anything to discourage foreign investment in Zambia for the next two decades or so. Consequently the endeavour of this Ministry will be to obtain the surrender of the unused mining rights voluntarily from the big mines. It will probably have to be in return for some counter-concession; e.g. relieving mining companies of some anxiety as to capital and income security for ten to twenty years or any agreed reasonable time period. All this will of course have to be worked out in the future.

(ix) There exist at the moment three small copper mines in Zambia. One is Allies Mine belonging to Sable Syndicate owned by three former native workers of the Roan Antelope Mine. On 19/6/62 the present operator acquired a tribute agreement from the owners for five years with an option of a renewal for a further five years subject to a 5% tribute payment or £10 per month. These rights were assigned to Continental Ores Ltd. which now owns 90% of the shares of the tributor company.

The second small copper mine is the Hippo Mine which is leased from the Kafue Development Company. The third is Mtuga Mine leased from Falcon Mines Ltd. The new leaseholders have reached an agreement with the Zambia Anglo-American on reasonable terms for prospecting the ad-

joining land.

Each of these existing small copper mines and those that might come into existence in future might become more viable if they were enabled to prospect vigorously beyond the boundaries of their present rights and find extension of their own ore bodies which would allow their operations to enjoy more of the economies of medium scale mines.

Zambia Anglo-American is already assisting a small mine (i.e. Hippo copper mine). This example might set a powerful precedent.

(x) Large mines have the technicians, the equipment and the finance for systematic and scientifically up-to-date training of manpower. Any professional, sub-professional and skilled miner would get the best training there. Intending small miners need, however, in addition, a different type of training. In their work they will be forced to improvise, to be masters of many trades, to work alone, relying on their own resourcefulness. Their supplementary training to acquire these capacities of self-reliance can come only from practising successful small miners. They are usually qualified mining engineers or geologists and have an all-round training and wide ranging experience. Any African whom they train would be trained in the entire range of mining pursuits such as prospecting, assaying, geological analysis, mapping, mining technology, etc. The importance of this mining training aspect of small mines cannot possibly be exaggerated.

One immediate reaction to all these considerations is the question of viability of a small mine. It is clear that a very important part of a small mines policy will have to consist of making sure from the outset that any small mine which was seeking registration could be economically viable. Nothing would be more irritating to the Ministry of Lands and Mines than having on its hands a lot of small mines, all

of which were unprofitable or bankrupt and clamouring incessantly for financial aid. The registration, in other words, would depend upon proof of viability. The small miner would therefore be required to give as much information concerning his prospect as possible to the authorities in the Ministry, on the basis of which the registration could or could not be executed. A more liberal approach would be to register all mines but only to give financial loans to viable ones. The trouble with this approach is that the process of registration may become a resource consuming exercise which is not economically justified by the status of the particular mine or prospective mine.

(C) ROYALTY FOR SMALL MINES - DETERMINATION

The value of a given tonnage of metalliferous ores in the ground at a small mine is likely to be less than the value of the same tonnage in the ground of a large mine. This is because in general large mines are low cost mines compared to small mines.

We outlined how this capital value, and the royalty associated with it, may be arrived at. In our computation schedule we lay out the principle by which this value may be allocated or distributed between the various critical claimants. Thus, from the value of a ton of refined metal at the (overseas) point of consumption is deducted items (2) to (9). The point is that small mines are faced with special cost factors not common to large mines. This raises the items (2) to (9) more for the small than for the large mines. Consequently this reduces the net capital value of the small mines compared to that of the large mine. Thus, not only must the small miner pay tribute (which we define below) to the large miners, but also must or may have to incur other special costs, like the following:

(i) A small mine has different transport costs from a large mine. The small mine is usually forced to build a feeder road to the nearest highway; this must also be maintained for the whole life period of the

mine.

(ii) The small mine is usually much further away from the main transport routes, i.e. the railway or the main trunk routes, than are the major mines. This inflates transport costs more for the small mine than for the large mine.

(iii) As they are often situated in rural areas which are malaria and sleeping sickness areas, small mines incur extra costs in fighting malaria and the tsetse fly to protect workers against disease. In most cases, large mines obtain these facilities from the social services of the government principally because of the locational advantages.

(iv) The comparatively small size of the ore reserves and the drawn out life of a small mine prevent the application of certain mining techniques, a fact which also gives rise to extra extraction costs.

It may very well be that after calculating the capital value of the mining programme of a small mine according to our formula the positive item $\left[(1) - (2) \text{ to } (9)\right]$ may be drastically reduced compared to the residual value of a large mine. That is, the likely effect of those special costs is to make the residual capital value of the small mine non-comparable to that of the large mine. This is what would make the royalty payable by a small mine smaller than that payable by the large mine.

Whatever the value of royalty that may emerge, this will be the specific royalty to the mine per ton of metal and may be expressed as a percentage of the selling price of the final product (i.e. ton metal) per given period of assessment of the small mines royalty.

Briefly recapitulated, the determining and the fixing of the actual royalty payment (or tax) is as follows:

(i) A six months moving average of LME prices centred in the current month is estimated by averaging the spot prices and the three months'

forward prices for the last three months.

(ii) From this moving average are deducted the standard extraction, transformation and intervening costs for the current or relevant period of assessment, per ton/metal.

(iii) The specific royalty per ton of metal remains in force until the next period of re-assessment of the small mines royalty.

As hinted above, this royalty system takes into account the tribute payments which the small mines make.

What in fact is a tribute payment? This is the payment which small miners make to the large mining companies: no mineral and mining rights of small Zambian mines belong at present to the small mine operator; all mines belong to the large mining companies some of which are registered in Zambia and others outside of it. These allow a small miner to operate the mines on payment of a "tribute" which is normally expressed in terms of a large percentage of the metal content of the ore mined. In the case of small copper mines, the tribute amounts to 5% of the LME price. For medium size mines the tribute payment may be 7% or more. Thus an operating small copper mine would have to pay this tribute plus the royalty, as presently assessed, of 13.5% LME price less £8 plus the export duty which as we have seen, is equal to 40% of the excess of the LME price above £300.

Thus, if tribute continues to be chargeable, this would be deducted from the value of the ores in the ground of small mines to arrive at the chargeable royalty.

Because of such special cost factors facing the small miner, it is desirable that whatever small mine royalty is payable under the above provisions, it should be payable by the small miner only after he himself has received payment for the product of his mine. This is strictly a matter of liquidity considerations.

Moreover, it may be desirable to entitle an owner or operator

of a small mine to apply for the deferment of the royalty payment in case he needs further productive investment in the mine to make it more viable, e.g. by enlarging its output capacity or modernizing its production technique, but is unable to raise the capital. The time allowed for the deferment can be decided on. But a period half the working life of a small mine would be adequate if that life is not more than, say, three years. It must, of course, be ensured that the royalty so deferred is invested, in accordance with the agreement, in the creation of output capacity.

Alternatively, the government may provide loan facilities for such small mines which need funds for mine purposes but cannot raise them elsewhere because the cost of the funds is prohibitive.

REFERENCES AND FOOTNOTES

1. T.J.Hoover, op. cit. p.1 et. al.

   R.D.Parks, op. cit. pp.1-2

2. Truscott, op. cit., p.233

3. See Chile's Mineral Law No. 16425 of January 25 1966;

   Also Appendix 2 of this study.

4. See R.L.Prain, Sir, (Selected Papers 1958-60) op. cit.

5. For instance Bwana Mkubwa Mine, Kansanshi Mine, etc.

CHAPTER 8

OTHER TAX PROPOSALS FOR SMALL MINES: EXPORT AND INCOME TAX

Having made our proposals on the system of royalty payment for both large and small mines, we can do no more in this chapter than make a brief comment on measures that could be adopted to complement our proposals specially for small mines.

In Chapter IV, we were particularly critical of the Income Tax Bill in its application to the small mines. It is thus natural that after discussing the royalty formula we should now turn to these other related tax structures.

(a) INCOME TAX AND DEPLETION ALLOWANCES FOR SMALL MINES.

As we will recall, the present Income Tax Bill is indiscriminate in its application between small and large mines. Yet we know that although it is possible to distinguish the income of a large corporation into corporation income and personal (or shareholders') income, it is almost impossible to make the same distinction regarding the income of a small operator. For a small operator the "corporate" income and the personal income are hardly separable; the two components, to the extent that they can be distinguished as such, merely form a total gross profit for the small operator.(1)

It therefore seems only logical, in the name of equity or fairness, that appropriate adjustments should be made to take account of such and other considerations. We thus suggest that the main concession as regards the income tax on small mines, should consist in allowing the sole proprietors or self-employers to deduct from the net profit an imputed salary for his own services. This salary would have to be equal to, say, a manager's salary. He would, of course, be liable to a private or personal income tax on this imputed salary.(2)

The imputed salary would naturally reduce the net profit of the small mine very much. Nonetheless, a general system of profits taxation would go something like this: from the gross profit (or simply the total revenue return) would be deducted the depletion allowances, the redemption allowances, the imputed salary and the full mine royalty, including the tribute payment.(3) The remainder would then be liable to taxation according to the prevailing system. From what we have been of the attendant cost factors of small mines, the net taxable profit would, in many cases, be fairly small.

It may also be necessary to defer the income tax in case the small miner puts up a creditable case that the deferment of the income tax is necessary to enable him to create extra output capacity or introduce more profitable production techniques which would enlarge the future income tax receipts.

Like the profits tax provisions of the Income Tax Bill, it would be desirable to relate depletion allowances(4) to the special conditions of a small income as distinct from a large mine. Thus, since depletion is deductable from the income of the project to arrive at taxable profit, the part of this allowance which cannot be offset by the depletion allowance provisions may be offset by providing tax concessions for the small miner in other directions; if this proved insufficient the residue of the depletion allowance could then be offset against say, the royalty payment. Should there still be an uncompensated balance of the depletion allowance, it might then be regarded as constituting a tax credit which would be carried forward to the next fiscal year (or years) in which they would be offset against net profits earned (5) (i.e. before taxation).

It is needless to state that in order to safeguard possible wastage of capital through various concessions, an application by a

small miner for deferment to the next fiscal year of royalty and/or export duty would be granted only if he advanced reasonable proof that the capital allowance to which he was being entitled in the current year would be equalled, but preferably exceeded by subsequent earnings of the mine.

(b) EXPORT DUTY FOR SMALL MINES.

We mentioned earlier that the export duty is payable to the Government of Zambia within the month in which output is exported, and that the mining companies do not receive payment for their product for at least three months after exportation.(6) For a large or rich enterprise this system may be allowed to operate without (apparent) objections from the mining companies. The liquidity problem is not immediately relevant for the richer or larger mine.

With particular reference to small mines, a rational system would be to provide that the export duty on the products of small mines should not be payable simply in relation to the month in which output was exported. Rather, the payment should be made only after payment for the products of the small mine has actually been received by the small miner.

As in the case of profits or income tax, it may prove just as prudent to permit small mines to apply for a deferment of the export duty if this could enable them to make additional investments to create extra output capacity, or introduce more profitable production techniques. Where this were the case, the Export Duty would then have to be paid in the subsequent or later charge year. (7)

CHAPTER 8

REFERENCES AND FOOTNOTES

1. In contrast, see tax treatment of small mines in Chile, Appendix 2 of this study.
2. See O.E.C.D. Report, op. cit. Esp. Chapter 2.
3. See definition of "Tribute Payment" in Chapter 7 of this study.
4. See Chapters 3 and 4 of this study.
5. See O.E.C.D. Report, op. cit., Chapter 2, Section 10: "The Taxation Treatment of Losses".
   R.A.Musgrave, op. cit. on depreciation and treatment of losses.
6. See Chapter 5 of this Study.
7. Ref. as at (5) above - Taxation treatment of losses.

CHAPTER 9

SUMMARY AND CONCLUSION

The main argument for our proposed royalty formula is that it is specific to the mine and is determined rationally on the basis of crucial relevant factors of the enterprise, given Government policy on the other hand. It may, to that extent, be regarded as something of a blueprint for both the legislators and the miners who find themselves in a situation similar to that which obtains in Zambia. The formula is, of course, specifically intended to deal with the problem as it is today in Zambia.

Once we have determined our royalty, we could then integrate it into the whole system of taxation of mines in Zambia. Essentially our royalty system attempts to relate tax liability to productivity and profitability. A special aspect of it is that it permits all profits due to reduction of costs during a specified period to be treated as net profits i.e. our royalty tax will not fall on this form of income. The idea is, of course, to encourage enterprises to be more efficient, since any efficiency gains are not taxable income. The effect would, of course, be to raise the marginal productivity of capital in the mining industry. This would be a most desired effect since it would imply expansion of the sector. And there is nothing which would improve the fortunes of Zambia more than the expansion of this sector. We have stressed what an important role this sector plays in the economic life of the people of that country.

In particular, with the objectives of the current development plan,(1) Zambia's needs for a wider revenue capacity from the mining sector cannot be overstressed. It is significant, but not surprising that the first of the eight goals in the development plan 1966-70, is the desire and need to diversify the economy so that eventually the economy can rely less and less on the fortunes of the copper industry. More manufacturing, agriculture and other

enterprises are needed in Zambia. But to achieve this and other plan targets, an enormous amount of resources will be required in the hands of the Government and all concerned. This fact is clearly recognised in the country's Financial Plan to cover this plan period.(2)

It cannot be said too often that, for a start, a higher productivity in the mining sector is crucial for practically all the development needs of Zambia. It may be argued, however, that although this is largely true, it could defeat its own purpose. Thus, as the industry becomes more productive, it also becomes more attractive to capital which would otherwise have gone into other lines of production. If this were to happen, the set-out purpose of diversification through the mining sector would hardly be achieved. Both domestic and foreign capital would find that the mining industry was the only sector worth investing in.

This is, of course, where the fiscal and monetary authorities must come in. Ideally, they should continue to encourage a higher productivity in the mining sector, but giving at the same time particular attention to the evils of perpetuated monopolistic or lop-sided economy. We have seen that some of the justification for introducing the export duty was to regulate this tendency. However, the Government cannot simply be content with regulation of the tendency. It has to go into business itself to establish at least the basic rudiments of a diversified economy.(3) This does not necessarily mean that the copper industry has to be subjected to a stifling tax system in order to avoid the economic imbalance and to secure resources for establishing other enterprises. This attitude could lead to the same adverse effects - killing the goose that lays the egg, or, as some authors have put it, draining the fish pond in order to catch the fish.

Happily, the current Zambian Plan appreciates these difficulties. The idea is to tap all sources of resources possible to meet the objectives of the Plan.(4) Thus the Plan estimates a recurrent revenue of about £524.8m. for the needs of the Plan, and will be raised from various sources. It is further expected that the State will raise loans, domestically, amounting to ab ut £30m. Moreover, the Government expects to secure external resources in the form of loans and foreign aid, estimated at about £58m. and £5m. respectively.

On a general level, the Plan estimates that at a price of £360 per ton of copper metal, expected revenue from all taxes could range from £70m. to £90m. per annum over the period in question. Note here, once more, the dependence of the economy on the well-being of the copper industry.

Such are some of the considerations on the basis of which Zambia's revenue-expenditure processes must be conceived. The successful implementation of the whole development plan will depend very much on the economic and administrative capacity of the tax system to marshal the necessary resources, just as the level of expenditure will depend largely on the effectiveness of the tax system in terms of productivity, efficiency and stability.(5) The whole revenue-expenditure process itself can only be deemed successful or otherwise in terms of the extent to which the Plan objectives or the envisaged structural changes have been occasioned.

Needless to mention in this connection that the very basis of a successful small enterprise policy depends on what happens in the overall revenue-expenditure process. Thus policies designed to encourage small enterprises to spring up and to grow are hardly possible, in view of the demands on resources and which such small enterprises make, without the backing of an efficient revenue-expenditure system. Thus the whole essence of our small mines royalty policy is underlined by the basic assumption that

resources to carry out such a policy are available, and that to the extent that they are available, they will be utiliged economically, productively. This is also why we make the point that in practice, any small miner applying for registration, would have to pass the viability test. This, as can be seen, is an insurance against wastage of extremely scarce resources, which could be employed elsewhere perhaps better and more productively.

We believe that our royalty system recommends itself to all interested, and if adopted it would do much justice to what has hitherto been an ad hoc, unproductive and inequitable system of mine taxation. We believe too that in view of all that we have said, a policy of diversification is not only desirable, but feasible within defined limits. We specially address ourselves to the particular needs of Zambia today.

CHAPTER 9

REFERENCES AND FOOTNOTES

1. See National Development Plan, op.cit., Pp. 5-8

2. See National Development Plan, op.cit. - Financial Statement, Pp. 11-15

3. The Indeco (Industrial Development Corporation) - State sponsored body, has special significance in this respect. Its role in establishing enterprises on behalf of the Government is invaluable. See "The London Times" November 18 1968 - Supplement on Economics and Politics of Zambia since 1964.

4. See National Development Plan, op.cit., as at (1) above.

5. On Taxation and Productivity, see a discussion in the O.E.C.D. Report, op.cit., Pp. 8-11.

APPENDIX ON MINE-COMPANY TAXATION

APPENDIX I: MINE TAXATION IN CANADA

(1) The Income Tax Act (at 1966)

Income tax is levied on both personal and corporate incomes. Personal levy is graduated to vary directly with taxable income.

(2) Corporation Tax Rate (on and after Jan. 1st 1961)

18% on the first $35,000

47% on the excess over $35,000

Additional tax of 3% imposed under the provisions of the Old Age Security Act.

(3) Capital Cost Allowance

(a) Depreciation

Assets acquired for the purpose of producing income from a business are, dependent upon their nature, segregated into various classifications. Rates for each such class are stipulated for the purposes of determining the maximum annual deduction, computed on a diminishing balance basis, which may be used in computing income, thus:

Asset:

(i) Mining, machinery and equipment acquired for the purpose of gaining or producing income from a mine

Class of Asset 10

Rate of Charge 30%

(ii) A mine shaft, min haulage way or similar underground work designed for continuing use, or any extension therof, sunk or constructed after the mine came into production, cost of designing, supervision

Class of Asset 12

Rate of Charge 100%

Capital cost allowance is not compulsory and any write-off up to the maximum permitted for the particular class may be taken in the year.

In the event of the disposal of depreciable property, the allowance may be subject to recapture.

(b) Depletion:

Operators: An allowance (commonly referred to as "depletion" is permitted as a deduction in computing the income of the operator of a mine or oil or gas well. This deduction is primarily intended to compensate for the exhaustion of the natural resource.

The amount deductable for a number of items including a metalliferous mine (except a gold mine) is 33⅓% of the aggregate of the profit from all such mines, wells and deposits, less certain deductions, including prospecting, exploration, drilling and development expenses.

N.B. "Operator" includes a person who has an interest in the proceeds of production from an oil or gas well, or a mine under an agreement which provides that he shall share in the profits remaining after deducting the costs of operating the well or mine.

"Non-Operator": A person other than an operator - with an interest in a well or mine and in the proceeds from the sale of the products therefrom or receives a rental or royalty computed by reference to the amount or value of the production from a well or mine: deduction allowed = 25%.

(4) 36 Months Exemption for Mines

A corporate, in computing its income, is not required to include the income derived from the operation of a mine for the period of 36 months commencing with the day on which the mine came into production in reasonable

commercial quantities.

The date on which a mine comes into production is a question of fact and is determined on the basis of all relevant information available at the time the claim for exemption is made.

(5) Exemption from Tax of Properties and Grubstakers' Gains

Bona fide prospectors and the persons who employ them or provide the financial backing for their prospecting activities are exempt from tax on amounts received from the sale of all or any part of an interest in a mining property acquired as a result of the prospectors' efforts, other than rents, royalties or similar payments received. If the consideration for the interest is shares of the capital stock of a corporation, rather than cash, any revenue derived from the subsequent sale of these shares is also exempt unless the owner disposes of them during or after carrying on a campaign to sell shares of the corporation to the public.

Amounts received from the sale of shares acquired by the exercise of an option which was accepted as consideration for the property are not exempt from tax.

(b) Exploration and Development Expenses.

Prospecting, exploration, drilling and development expenses incurred, including general geological and geophysical expenses, may be deducted in computing the income of certain corporations. The corporations entitled to this benefit are those whose principal business is, for instance:

(i) Mining or exploring for minerals, or

(ii) fabricating metals.

etc.

These expenses incurred in a year are deductable in that year to the extent of the corporation's income from all sources. If the aggregate

of such expenses exceeds the income, the excess may be deferred and is deductible from the income of subsequent years.

(7) Tax on Dividends

A tax of 15% is imposed and collected at the source on dividends paid to non-residents. Effective June 14, 1963 the tax will be reduced to 10% if the payer corporation has a degree of Canadian ownership. Tax paid at the former rate, however, is subject to a refund of one-third thereof, if the corporation acquires the necessary degree of Canadian ownership not later than in its first taxation year, commencing on or after January 1, 1967.

Source: re: Summary Review. Fed. Taxation & Legislation Affecting The Canadian Mineral Industry - Mineral Information Bulletin: MR 82 by E. C. Hodgson & W. J. Beard, Mineral Resources Division, Dept. of Mines & Technical Surveys, Ottawa.

Also See: "Taxation in Canada" by J. H. Perry - esp. Pp. 236-249 and Mining Journal Vol. 271, July 5/68 - Mine Taxation in Ontario, Decisions Pending Pp. 5-6.

APPENDIX II: SUMMARY OF CHILEAN TAX SYSTEM APPLICABLE TO MINING COMPANIES

1. Classification of Mines into Small, Medium and Large

Legally, medium mines are those which produce less than 75,000 LT/yr of metallic copper but which are not small mines. The latest are small operations defined in function of amount of capital and comparative status.

2. Rate of Taxation

(a) Small Mines: Rate 2% on sales proceeds

(b) Large Mines: Low No. 16425 at January 25 1966 legislates the general system applied to

(i) Chile Exploration Co. (Chuquicamata) 52.5%

(ii) Andes Copper Mining Co. (El Salvador) and any other company: Rate 50%.

(c) Joint Mining Companies (Chile has at least 25% of capital stock) and Medium Mining Companies. These have the general system applicable to any industry in accordance with the tax law with:-

(i) Rate of no less than 15%.

The actual rates are:

El Teniente 51%, Govt. of Chile 20%

Minera Andina 25%, Govt. of Chile 15%

Minera Exotica 25%, Govt. of Chile 15%

(ii) Tax of 30% on dividends of foreign shareholders if sent abroad.

(d) Housing Plan: 2% tax if the Company has an agreement with Housing Corporation.

(e) Copper Corporation: Commission of 0.25% which is considered as an expense.

3. Resulting Govt. Rate in Joint Mining Companies (From Taxes and participation which include risks as Capitalists

(i) Rate 20%, and Participation 51%

Tax 19.6% (because 20% applicable ex. - 2% Housing)

Housing 2.0%

=21.6%

Remainder 78.4% is divided 51% Govt. and 49% Foreign investors

That is:- 39.984 and 38.416

If the foreign investor sends his total revenue abroad, his share of 38.416 will pay 30% tax, that is: 11.5248.

Finally the Government (and the Housing Corporation) gets from taxes and participation, viz:-

21.6 + 39.984 + 11.5248 = 73.1088 and

Foreign Investor gets 26.8912 26.8912

Total Income = 100.000

Of which Govt. taxes & Participation = 73.1088%

From the point of view of the foreign investor who only invests 49% in the business, for each 100 of his Shares he pays:

Tax	100
-	26.6
	78.4
30% Dividend	23.52
Net Earnings	54.88

That is, the foreign investor's total tax on his share equals 45.12%.

(ii) Rate 15%, and Participation 25%

Tax 14.7% (because 15% applicable ex-2% Housing)

Housing 2.0%

=16.7%

Remainder 83.3% is divided 25% Govt. and 75% foreign investor

That is 20.825 and 62.475.

If the foreign investor sends his total revenue abroad, his share of 62.475 will pay 30% tax, that is 18.7425.

Finally, the Government (and the Housing Corporation) gets from taxes and participation:

16.7 and 20.825 18.7425 = 56.2675, and the foreign investor gets 62.475 - 18.7425 = 43.7325

Total Income = 100.000

of which Government Participation and Taxes 56.2675%

From the point of view of the foreign investor who only invests 75% in the business, for each 100 of his share, he pays

Tax 100

\- 16.7

30% dividend on 83.3 24.99

Net Earnings 88.3 - 24.99 = 58.31

That is, 41.69% total tax on his share

Source: Extract from MLM/4915/4.

APPENDIX III: MINING INCOME TAX (COMPARISONS)

a. CHILE (Large copper mines)

(i) Mixed Societies: (Present capacity 200,000 ST/Yr; future capacity 460,000 ST/Yr)

Sociedad Minera "El Teniente" (Kennecott Corporation)

Soc. Minera Andica (Cerro Corporation) and Soc. Minera Exotica (Anaconda Co.) which have 20% or 15% of income tax (less some allowances) plus 30% tax on the dividends sent abroad. That makes around 40% of taxation for the foreign investor.

(ii) Chile Explorations (Present capacity 300,000 ST/Yr., future capacity 390,000 ST/Yr.)

Income tax 52.5%, less some allowance could be estimated around 45%.

b. PERU

(i) Income tax on a sliding scale with maximum of 35% with some special abatements (30% tax for the Southern Peru Copper Corporation)

(ii) Depletion allowance of 15% of the grossvalue of production but not more than 50% of annual taxable profits.

(iii) Allowance to depreciate the prospecting expenditure

(iv) Undistributed taxable profits with rates 11% and tax on dividends 26%

The combination of all these taxes and allowances results in an average income tax of around 45% (Southern Peru would be around 40%).

c. U.S.A.

Income tax for the mining industry of 48% less depletion allowances, makes an average of 40% to 42%.

d. CANADA

Comparatively very favourable system. E.G.: the international Nikel Company has paid 30% to 33% of taxes in the immediate past years.